DOCUMENT RESUME

ED 317 786 CE 054 570

AUTHOR	Metcalf, David H.
TITLE	The Economics of Vocational Training: Past Evidence and Future Considerations. World Bank Staff Working Papers Number 713.
INSTITUTION	World Bank, Washington, D. C.
REPORT NO	ISBN-0-8213-0475-5
PUB DATE	85
NOTE	169p.
AVAILABLE FROM	Publications Sales Unit, Dept. T, World Bank, 1818 H Street, N.W., Washington, DC 20433.
PUB TYPE	Information Analyses (070)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Cost Effectiveness; Developing Nations; *Economic Research; Educational Economics; *Education Work Relationship; Foreign Countries; *Input Output Analysis; Job Training; Labor Force Development; *Outcomes of Education; Resource Allocation; *Vocational Education
IDENTIFIERS	India; Israel; Kenya; Latin America

ABSTRACT

A partial survey of the literature on the economics of vocational training reveals three important lessons on how evaluations may be undertaken using data on pay, inputs, and outputs. The first lesson is that social, corporate, and private returns to vocational training in developing countries appear to be high enough to justify expanding training activity. However, training in industrial institutes and vocational secondary schools is less cost-effective than more formal firm-based training, at least in Kenya, India, and Israel. Also, Latin American data indicate that school and formal institutional vocational training may be substituted for one another. The second lesson is that in some sectors a more labor-intensive method of production is economically more effective than current methods. This may, in turn, imply the need for more--not less--skilled labor and vocational training. Further, given technology and output, unskilled and skilled labor appear to be substitutes, rather than complements, in the production process. The third lesson is that sophisticated function analyses are plagued by statistical and measurement problems. If they are not resolved, estimation techniques are unlikely to be able to pick up any relationship between trained labor and output among firms. However, there are alternatives. Many input and output measures such as performance rating and downtime are available for more modest evaluations. Training can be evaluated using earnings data or output and input data. In all cases, there are technical problems including sample size, control groups, the use of longitudinal data, and difficulties caused by labor mobility. A simpler before/after plant level study of changes in inputs or output associated with training may offer the most tractable evaluation. (112 references.) (Author/CML)

ED317786

WORLD BANK STAFF WORKING PAPERS
Number 713

The Economics of Vocational Training

Past Evidence and Future Considerations

David H. Metcalf

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

J Feather

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CE054570

The World Bank
Washington, D.C., U.S.A.

BEST COPY AVAILABLE

Copyright © 1985
The International Bank for Reconstruction
and Development / THE WORLD BANK
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.

All rights reserved
Manufactured in the United States of America
First printing April 1985
Third printing October 1987

This is a working document published informally by the World Bank. To present the results of research with the least possible delay, the typescript has not been prepared in accordance with the procedures appropriate to formal printed texts, and the World Bank accepts no responsibility for errors. The publication is supplied at a token charge to defray part of the cost of manufacture and distribution.

The World Bank does not accept responsibility for the views expressed herein, which are those of the authors and should not be attributed to the World Bank or to its affiliated organizations. The findings, interpretations, and conclusions are the results of research supported by the Bank; they do not necessarily represent official policy of the Bank. The designations employed, the presentation of material, and any maps used in this document are solely for the convenience of the reader and do not imply the expression of any opinion whatsoever on the part of the World Bank or its affiliates concerning the legal status of any country, territory, city, area, or of its authorities, or concerning the delimitation of its boundaries, or national affiliation.

The full range of World Bank publications, both free and for sale, is described in the *Catalog of Publications;* the continuing research program is outlined in *Abstracts of Current Studies.* Both booklets are updated annually; the most recent edition of each is available without charge from the Publications Sales Unit, Department T, The World Bank, 1818 H Street, N.W., Washington, D.C. 20433, U.S.A., or from the European Office of the Bank, 66 avenue d'Iéna, 75116 Paris, France.

David Metcalf is professor of economics at the University of Kent, England, and a consultant to the Education and Training Department of the World Bank.

Library of Congress Cataloging in Publication Data

Metcalf, David H.
The economics of vocational training.

(World Bank staff working papers ; no. 713)
Bibliography: p.
1. Occupational training--Developing countries.
2. Vocational education--Developing countries. I. Title.
II. Series.
HD5715.5.D44M48 1985 338.4'7373246'091724 84-27098
ISBN 0-8213-0475-5

Abstract

This paper (i) presents a partial survey of the literature on the economics of vocational training to draw some lessons for evaluations and (ii) indicates how such evaluations may be undertaken using data on pay, inputs and outputs.

There are three important lessons. First, social, corporate and private returns to vocational training in developing countries appear to be high enough to justify expanding training activity. However, training in industrial institutes and vocational secondary schools is less cost-effective than more informal firm-based training, at least in Kenya, India and Israel. Also, Latin American data indicate that there may be substituability between schooling and formal institutional vocational training. Second, in some sectors a more labour-intensive method of production is economically more efficient than current methods. This may, in turn, imply the need for more, not less, skilled labour and vocational training. Further, given technology and output, unskilled and skilled labour appear to be substitutes, rather than complements, in the production process. Third, sophisticated production function analyses are plagued by statistical and measurement problems. If they are not resolved, estimation techniques are unlikely to be able to pick up any relationship between trained labour and output among firms. However, there are alternatives. Many input and output measures such as performance rating and downtime are available for more modest evaluations.

Training can be evaluated using earnings data or output and input data. In all cases there are technical problems including sample size, control groups, the use of longitudinal data and difficulties caused by labour mobility. In the face of such problems with earnings data a simpler before/after plant level study of changes in inputs or output associated with training may offer the most tractable evaluation method.

Acknowledgement

I acknowledge, with thanks, helpful conversations with Bank Staff, Mark Blaug, Martin Godfrey and Stanley Nollen. George Psacharopoulos made helpful comments on earlier drafts. Constructive and insightful comments were received when the paper was presented at a seminar at the Bank in April 1984. John Richards provided research assistance on Section 4.

Condensé

La présente étude i) est une enquête partielle des documents relatifs à la rentabilité de la formation professionnelle, destinée à tirer les leçons de l'expérience, et ii) indique les méthodes d'évaluation de la formation professionnelle fondées sur les données relatives au salaire, à la production et aux facteurs de production.

Selon ses conclusions, trois leçons importantes peuvent être dégagées. Premièrement, il semble que les avantages de la formation professionnelle, sur le plan social et privé et du point de vue de l'entreprise, soient suffisants pour justifier son développement. Toutefois, la formation prodiguée dans les instituts industriels et les établissements secondaires d'enseignement professionnel est moins rentable qu'une formation moins structurée, au sein de l'entreprise, du moins dans des pays tels que le Kenya, l'Inde et Israël. D'autre part, selon les données recueillies dans les pays d'Amérique latine, l'enseignement normal et la formation professionnelle structurée dispensée dans des institutions peuvent se substituer l'un à l'autre. Deuxièmement, une méthode de production davantage axée sur le recours intensif à la main-d'oeuvre s'avère plus rentable, dans certains secteurs, que les méthodes actuellement utilisées. De cette conclusion il découle qu'une main-d'oeuvre qualifiée plus abondante est nécessaire, par conséquent que l'expansion de la formation professionnelle s'impose. Par ailleurs, compte tenu de la technologie et de la production, main-d'oeuvre qualifiée et non qualifiée semblent interchangeables et non pas complémentaires dans le processus de production. Troisièmement, les analyses approfondies de la fonction de production se heurtent à des problèmes de statistiques et de calculs. Si ces problèmes ne sont pas résolus, il est peu probable que les méthodes d'évaluation seront à même de déceler toute relation, quelle qu'elle soit, entre main-d'oeuvre formée et production, d'une entreprise à l'autre. Il existe, cependant, d'autres méthodes d'évaluation, fondées sur bien d'autres critères, notamment performance et temps d'arrêt, dont le champ est plus limité.

Les données relatives aux salaires ou aux facteurs de production et à la production peuvent permettre d'évaluer la formation. Dans tous les cas, des problèmes techniques se présentent, notamment à propos de la taille de l'échantillon, des groupes de contrôle, de l'utilisation de données longitudinales et de la mobilité de la main-d'oeuvre. C'est pourquoi la comparaison des fluctuations des facteurs de production ou de la production d'une entreprise, avec et sans formation, représente peut-être la méthode d'évaluation la plus facile à appliquer.

Extracto

El presente documento tiene dos finalidades: i) presentar una reseña parcial de la literatura existente sobre la economía de la formación profesional a fin de extraer algunas enseñanzas para las evaluaciones, y ii) indicar cómo se pueden llevar a cabo tales evaluaciones usando los datos de sueldos, insumos y productos.

Se han extraído tres importantes enseñanzas. La primera es que la rentabilidad social, empresarial y privada de la formación profesional en los países en desarrollo parece ser suficientemente elevada para justificar la ampliación de los servicios de capacitación. Sin embargo, la formación impartida en institutos industriales y escuelas técnicas secundarias es menos eficaz en función de los costos que la más informal impartida en las propias empresas, por lo menos en Kenya, la India e Israel. Además, los datos de América Latina indican que tal vez haya posibilidades de sustitución entre la instrucción escolar y la formación profesional formal impartida en instituciones. La segunda es que, en algunos sectores, un método de producción basado en el uso intensivo de mano de obra es económicamente más eficiente que los métodos actuales. Esto a su vez significaría que se necesita más mano de obra calificada y formación profesional, y no menos. Asimismo, a determinados niveles de tecnología y producción, la mano de obra no calificada y la calificada al parecer se sustituyen entre sí en vez de complementarse en el proceso productivo. La tercera es que los análisis complejos de las funciones de producción se ven dificultados por numerosos problemas estadísticos y de medición. Si éstos no se resuelven, no es probable que las técnicas de estimación permitan determinar la relación que pueda haber entre el uso de mano de obra adiestrada y la producción de una firma en comparación con otras. Sin embargo, hay otras alternativas. Para las evaluaciones más modestas se dispone de numerosas formas de medir los insumos y productos, como la evaluación de la eficiencia del desempeño y del tiempo improductivo.

La eficacia de la capacitación se puede evaluar usando datos de las remuneraciones o de los insumos y productos. En todos los casos se plantean problemas técnicos, incluidos el del tamaño de la muestra, los grupos de control, el uso de datos longitudinales y las dificultades causadas por la movilidad de la mano de obra. Dados los problemas con los datos de las remuneraciones, es posible que un estudio más sencillo, a nivel de las fábricas, sobre las variaciones en los insumos o productos antes y después del adiestramiento, constituya el método de evaluación más factible.

Summary

Over a decade ago Mark Blaug - one of the founding fathers of the economics of education and training - wrote: "We may as well confess that we know almost nothing about the economics of training, its incidence, its costs and its benefits." Clearly any economic analysis of training must be tentative, but this paper suggests that it is now possible to say some sensible things about the evaluation of training.

This paper has two purposes. First, a partial review of the literature on the economics of vocational training is presented (Sections 2-5). This review is not conducted in a vacuum. It feeds into the second purpose, which is to illuminate methods of evaluating vocational training (Sections 6 and 7).

Vocational skills are important. Therefore Section 2 examines the "where", "when" and "how long" of vocational training. It is possible to think of vocational training being located along a continuum. At one extreme is secondary school-based training. Next comes training in institutions like the vocational secondary school in Israel. Then comes the South American type of sandwich training of the SENAI or SENATI variety. Finally there is firm-based training.

It is difficult to generalise on the basis of the studies examined in this section because there is no guarantee that the results would be replicated over time or across countries. The countries for which LDC case studies are available include: Malaysia, Israel, India, Kenya, Brazil,

Chile, Colombia and Peru. Nevertheless, some tentative conclusions are possible. First, where the rationale for the study was to see if any expansion in training facilities was justified the rate of return was typically high enough to justify such an expansion. Second, there is some evidence that in Brazil and Peru short courses have a bigger payoff than longer courses of training. Third, training in industrial institutes and vocational secondary schools is less cost effective than more informal firm-based training, at least in Kenya, India and Israel. Fourth, the payoff to quasi-institutional vocational training in South America is higher for those who have only completed primary school than for those who have completed secondary school. This suggests that extra formal schooling may be substitutable for formal institutional vocational training. For a given length and type of vocational training there are diminishing returns to formal schooling.

Evidence (Section 3) from industrialised countries show that the private labour market may fail to provide sufficient trained labour because of labour mobility among firms, borrowing difficulties for trainees or because trainees' wages are set too high. These factors all provide justification for public intervention in the training effort.

Empirical estimates of the substitution technically possible between more skilled and less skilled labour is reviewed in Section 4. The results have two important implications for vocational training. First, economically efficient production technologies sometimes imply more labour intensive technology which, in turn will tend to raise the demand for skilled labour and in turn, vocational training requirements increase. Second, in general, holding output constant, less skilled labour is, apparently, a substitute for skilled labour in the production process rather than a complement to it. Indeed, it may well be that the studies surveyed here understate the true degree of substitutability among different labour types. Thus labour is usually measured according to the occupation-description ("electrical engineer") rather than what the person actually does ("maintenance technician"). Training design certainly needs to operate on the basis of tasks rather than labels. Although the studies surveyed in this section do not relate specifically to the level of the firm (typically the data refer to industries or whole economies) the possibility that less skilled labour is substitutable for more skilled labour, and vice versa, needs careful investigation prior to any evaluation of vocational training.

Firm level training studies (Section 5) are quite rare but the economic analysis they contain is generally excellent. 1/ There are several conclusions to note. First, sophisticated production functions are unlikely to be able to pick up any relationship between trained labour and output at the level of the firm. The main reasons are

---

1/ Much World Bank training is also firm-related training so these firm studies provide helpful guidance, particularly on the benefits side of the training equation.

statistical: aggregation biases; measurement of variables; selectivity biases. Second, individual performance ratings are a sensible and useful method of measuring individual productivity, as evidenced by a number of successful studies in developing as well as developed countries. Third, downtime is a potentially valuable intermediate measurement of output. Fourth, although pay is usually a good indicator of the value of a person to the firm, it is not always. Therefore, when training is being evaluated, if pay is used to measure the value of output a cost-benefit framework will generally be accurate but, on occasion, it may not give correct results.

Methods of evaluating the external efficiency of vocational training using earnings data are discussed in Section 6. This section draws, in particular, on the illumination provided by the firm-based studies and the extensive literature on the evaluation of public manpower and training programmes. Methods and objectives are discussed first. Then various technical problems are elaborated, including: sample size, control groups, the use of longitudinal data and problems caused by labour mobility. Finally, the relationship between pay and the productive value of the individual is analysed. Many factors exist which might drive a wedge between earnings and the true worth of the individual to the firm. These factors include: union monopoly power, the fact that a skilled person may raise the productivity of co-workers, and labour shortages and surpluses. Therefore care must be taken when estimating the corporate and social rate of return to vocational training.

The cost-effectiveness of vocational training can also be analysed using output and input data (Section 7). A number of promising output and input measures exist. For example a before/after study could be based on the output of particular individuals using, for example, piece-work earnings or performance ratings to capture productivity changes associated with training. Alternatively, training might be analysed at the plant level, using plant downtime or the value of production as the output measures or reductions in labour demand and other factors as the input measure associated with training.

Table of Contents

1. Introduction and Summary 1

    Purpose
    Internal efficiency and external efficiency of training
    Manpower requirements compared with rate of return analysis
    Summary

PART I VOCATIONAL TRAINING IN DEVELOPING AND INDUSTRIAL COUNTRIES, SUBSTITUTION AND FIRM-BASED STUDIES

2. The payoff to vocational training in developing countries: a review of the evidence 14

    Introduction
    The case for expansion of vocational training
    Cost effectiveness of vocational training
    Social rate of return to different modes of vocational training
    Relationship between formal schooling and vocational training
    The vocational school fallacy
    Summary

3. Public training programmes in industrial countries 45

    US public training programmes
    Vocational training in Britain
    Summary

4. Substitution 64

    Introduction
    Appropriate technology and the demand for skilled labour
    Substitution among different types of skilled labour
    Conclusion

5. Firm level studies 75

    Introduction
    Training costs
    Productivity, output and input
    Pay, productivity and experience
    Type of training and job performance/productivity
    Summary

PART II EXTERNAL EFFICIENCY OF VOCATIONAL TRAINING

6. Earnings-based benefit-cost evaluation of vocational training 95

    Objectives and methods
    Methodological problems: sample size, control groups, longitudinal data, labour mobility
    Earnings and output: non-competitive labour markets, externalities, disequilibrium
    Summary

7. Output-based and other evaluations of vocational training 127

    Methods
    Measures of output
    Benefits and costs
    Summary

SECTION 1

Introduction and summary

> "We may as well confess that we know almost nothing about the economics of training, its incidence, its costs and its benefits" (Blaug 1972 p.199).

> "A recent report by the National Academy of Sciences on the evaluation of manpower programs concluded that, after ten years of massive expenditures on manpower training programs and many evaluation studies, relatively little is known about their impact. This is a disturbing conclusion to have been reached about a program that has commanded a significant share of society's resources and has been on-going for more than a decade. Nevertheless one of the reasons for the ambiguous nature of the estimated impacts of manpower training programs is that the evaluation of such programs presents many difficult conceptual statistical problems that have not been well articulated in the literature. These problems arise from the difficulties inherent in analysing and comparing income streams over time for different sets of individuals whose characteristics are known only imperfectly". (Cooley, McGuire and Prescott 1979 p.120).

If these quotes are accurate (Blaug still believes so more than a decade later) any economic analysis of training must be tentative. Certainly the material here is put forward in a spirit of caution. However, some good studies have appeared in recent years and it is possible to draw some lessons from them concerning the evaluation of training.

1.1 Purpose

This paper has two purposes. First, a partial review of the literature on the economics of vocational training is presented (for an excellent previous review, up to 1973, see Zymelman 1976). Special attention is paid to those studies which (i) examine the relative merits of on-the-job versus off-the-job vocational training and the interaction between formal schooling and vocational training in developing and industrial countries; (ii) analyse substitution possibilities between capital and labour and between different labour types; (iii) throw light on the impact of training costs and on output. This partial review is not conducted in a vacuum. Its aim is to draw lessons concerning the evaluation of the external efficiency of vocational training. Thus the second purpose of the paper is to present some ideas for such an evaluation.

Training is like an iceberg - only part of it is in view. For example, the costs of off-the-job training in institutions are reasonably straightforward to calculate. But much of it is hidden from view: it is difficult to get at the costs and outcomes of things like "sitting next to Nelly", the loss of output attributable to skilled workers who spend some of their time training less skilled workers, and the value of output produced by the trainee. Further, post-training it is difficult to trace output to particular individuals. This suggests that case studies using before/after data or paired comparisons ("twins") are likely to be the most fruitful method of evaluating corporate training. This point may hold with special force for training associated with World Bank projects which often involve output like electricity supply, and road miles and port capacity where it would be specially difficult to identify output with any one individual. Even a case study is complicated by the heterogenous nature of such projects. Training varies by content, location and duration. Such diversity requires careful handling in evaluations.

Zymelman (1976 pp.9-11) provides a comprehensive list of training forms (see also Nollen 1983). He points out that there are three basic forms, each of which can be sub-divided:

- training on the job, both formal and informal;
- training off the job in schools, training centres or places of work;
- combined types of training such as apprenticeship with formal instruction off the job, on-the-job training with some related instruction, and cooperative-work training.

The type of training is described with some care when the payoff to vocational training in developing countries is analysed. But for the remaining sections the particular form of training is less important (for our purposes) - we are concerned with gaining insights which are relevant whatever the type of training.

In what follows, Part I presents evidence on three issues relevant to the examination of vocational training. These issues are: the payoff to vocational training in developing and industrial countries (Sections 2 and 3 respectively), substitutability (Section 4) and the methodology of firm-based training studies (Section 5). Part II then builds on this partial survey to draw some lessons and insights for evaluating the external efficiency of vocational training using earnings data (Section 6) or output and related data (Section 7).

1.2 Internal efficiency and external efficiency of training

The World Bank distinguishes between the internal efficiency of training and the external efficiency. Some care is needed here because different documents use these terms in slightly different ways. Consider the following descriptions or definitions:

Internal efficiency

" ... is used here in relation to how economically and successfully the trainees are being processed through their training program to its completion" (World Bank 1982 p.19).

"The evaluation of the training process ... can be measured by level of enrollments, dropout rates, graduation rates, teacher/student ratios, recurrent and capital costs per graduate, etc". (World Bank, no date, paras. 4.1 and 4.2).

"The internal efficiency of an institution is a measure of its health in terms of its internal operations. It covers, for example, the effectiveness of its management; the relevance and content of its courses; the quality of its teaching staff; the appropriateness of its equipment and its use; the adequacy of accommodation and its utilisation. It also brings into account questions of morale, motivation and staff and student relationships" (Hunting, Zymelman and Godfrey 1984, p.27).

External efficiency

" ... refers to the extent to which the trained persons proceed to jobs relevant to their training and how well they perform in the light of their training" (World Bank 1982, p.19).

"The evaluation of results or the impact of training on the production and productivity of the utility ... external efficiency could be measured (in the power sector) through observation of changes in indicators such as (a) production hours, (b) megawatts per worker, (c) gigawatt-hours of generated power per worker, (d) maintenance, (e) safety, (f) system losses, (g) staff turnover, (h) number of consumers/employees, (i) number of complaints, (j) performance of graduates on the job" (World Bank, no date, paras. 4.1 and 4.2).

" ... the external efficiency of the project (is evaluated) by comparing costs and outcomes" (Hunting, Zymelman and Godfrey 1984, p.55).

There is general agreement that internal efficiency refers to the training process - the identification, preparation and implementation of the components of training. To the extent that it has an economic dimension, the focus is on costs. The consequences of the training to the individual, the firm or to society do not come into it.

There is less agreement on what constitues evaluation of the external efficiency of training. The first description quoted is concerned with a narrow evaluation of training outcomes. Under this description costs are ignored and the outcome is limited to the kinds of jobs done post training and the performance of the trainees in these jobs. This omits many wider considerations. For example, the trainee may raise output among his colleagues or may move to another firm and raise output there. The second description (taken from the Power Projects Guidelines) presents a very comprehensive menu of measures of output, but an evaluation would also need to consider costs. The third document defines external efficiency in terms of both costs and outcomes.

The contents of this paper are addressed to the external efficiency of training. It is not concerned with the way in which training "needs" are identified nor with the process of training. Rather it focusses on costs and outcomes, leading up to a discussion of how the external efficiency of training can be evaluated. Thus it is orthogonal to the discussion of evaluation of internal efficiency in World Bank (1982). The evaluation method outlined in Part II is quantitative. However, there are also many qualitative dimensions to the external efficiency of training. These are well set out in the gestalt approach of Hunting, Zymelman and Godfrey (1984, ch.3). But the bottom line of any such evaluation must, if possible, be a cost-outcome indicator or a rate of return to training. So the dimensions of any qualitative evaluation are ignored here in an attempt to set out some of the issues when quantitative evaluations are required. This paper is therefore complementary to that of Hunting, Zymelman and Godfrey (1984).

No attempt is made here to set out a formal step-by-step method to evaluate, for example, the external efficiency of the training component in specific projects. (Both Stromsdorfer 1972 and Zymelman 1976 provide comprehensive descriptions of evaluation methods and problems). Rather, in Part I extant studies are analysed for the insights they provide and in Part II various evaluation guidelines are suggested and scrutinised.

World Bank project related training "seeks to provide specialised managerial, technical or operational skills pertaining to a particular enterprise or sector. Training by enterprise is restricted to specified jobs limited by the future scale of the enterprise and the number of employees in only one occupational category during a fixed period of time. Because the trainees are also employees, the problem of balancing supply and demand does not arise. Further, there can be significant spillovers of this training and experience into other activities" (World Bank 1980 p.47). In their comprehensive review the Operations Evaluation Department recently described PRT as a "traditional and inhibiting view" of the "training mandate" (World Bank 1982, para 18). The content of this paper is relevant to any evaluation of the external efficiency of training which aims to relate costs and outcomes. The analysis holds for sector wide training (e.g. the power sector rather than a particular power plant) and for vocational training projects such as those being undertaken currently by the World Bank in the Philippines and in Indonesia (World Bank, August 1982 and March 1983 respectively).

1.3 Manpower requirements compared with rate of return analysis

This paper is addressed to the ex post evaluation of vocational training. As such it does not have to enter the controversy concerning the relative merits of the manpower requirements approach and the price theory approach in the analysis of labour market skills (for an excellent synthesis see Freeman 1977; see also Psacharopoulos et al. 1983 for a recent examination of manpower planning). Nevertheless, it is worth briefly discussing these concepts because this helps to focus the content of the paper.

The manpower requirements approach projects manpower "needs" in any period on the basis of the industrial composition of output and employment and a fixed skill composition within industries. It deals exclusively with quantitative data, typically at a highly disaggregate occupation or industry level. The projected shortages (or surpluses) are identified by comparing needs with expected supplies.

The price theory approach analyses both the demand and the supply side of the labour market. On the demand side the key parameter is the elasticity of substitution between more and less skilled workers or between capital and labour. On the supply side, rates of return are calculated from earnings and information on investment in human capital.

The manpower requirements and rate of return methods can both be used to determine the desirable future structure of the labour force, and so suggest manpower and training requirements. In this sense they deal with one component of the efficiency of vocational training, namely the output (quantity and quality of labour) of the training programme compared with the ex ante indication of manpower needs (even when determining manpower needs alternative indicators are available, such as vacancy rates and changes in relative wages).

However, this paper only addresses itself to the manpower needs question in a tangential way, namely when it analyses substitution (Section 4). There it is shown, first, that where a more labour intensive technology is more efficient than existing technology the absolute number of skilled workers will tend to rise, implying a big payoff to vocational training. It is an open question whether production techniques on Bank projects are always appropriate. It is possible, for example, that there is little flexibility in production techniques in power and water supply but more flexibility in highway construction or irrigation technique. A more labour-intensive technology tends to require more unskilled and skilled workers. So if there is flexibility in the choice of technique this interacts with the labour supply and, in turn, influences the pattern of jobs "needed". Second, given the technology and output there is evidence that skilled and less skilled workers are substitutable in the production process. Similar evidence would be useful concerning World Bank projects. Presumably such substitution possibilities are generally considered to be limited - hence the need for vocational training. Putting the point differently: by what process is it possible to document so clearly the jobs where training is needed?

The main thrust of this paper concerns ex post evaluation of the external efficiency of vocational training (Sections 6 and 7). Here much of the discussion is cast in rate of return terms - a simple way of bringing together costs and benefits. This should not necessarily be taken to imply a preference for the rate of return approach over the manpower requirements approach when determining needs. It is simply that the manpower requirements approach, while useful in the ex ante analysis of training, is not relevant to the ex post analysis of costs and outcomes.

1.4 Summary

Vocational skills are important. The social rates of return to different modes of vocational training (Table 2.9) are nearly always acceptably high. Substitution in production to get the least cost input mix often implies the need for more skilled labour (Section 4). It is not always possible to substitute general education for vocational training when producing vocational skills. Therefore Section 2 examines the "where", "when" and "how long" of vocational training.

It is possible to think of vocational training being located along a continuum. At one extreme is secondary school-based training. Next comes training in institutions like the vocational secondary schools in Israel or the Indian Training Institutes. Then comes the South American type sandwich training of the SENAI or SENATI variety. Finally there is firm-based training, including World Bank project related training. It is not possible to generalise about the returns to these different forms of training - there are always exceptions to any general statement - but the weight of the evidence in Section 2 suggests that firm-based vocational training has a higher pay off than vocational training which mainly takes place in schools.

When should vocational training occur? There is some evidence that, for a given length and type of vocational training, there are diminishing returns to formal schooling. This raises the question: should vocational schooling come after primary or after secondary school? This issue is discussed in Sections 2.5 and 2.6. The major part of the evidence suggests that the returns to vocational training are lower for those who have taken secondary schooling than those who entered vocational training after primary school.

Finally, the duration of vocational training is important. In general the evidence in Section 2 indicates - for Israel and Peru for example - that short courses of vocational training have higher returns than longer courses.

Industrialised countries use resources equivalent to around 3 per cent of GDP on training. There are a large number of evaluations of training in such countries, particularly that provided or financed publicly. Some recent evidence is discussed in Section 3. It is shown that the private labour market may fail to provide an efficient supply of trained labour because of poaching, borrowing difficulties for trainees or because trainees wages are set too high. This provides a reason for public intervention in the training effort. In addition public provision of training is sometimes justified on equity grounds, to improve the lifetime chances of those towards the bottom of the occupational hierarchy. Most evaluations use information on earnings to get at the costs and benefits of training. Evidence suggests that the best such evaluations have data on both trainees and a control group of non-trainees and on earnings before and after training.

Substitutability is discussed in Section 4. The evidence presented is not relevant to any immediate evaluation of vocational training in a particular plant. Rather it is relevant at one remove: care should be taken both with the choice of technology and with the mix of labour employed to produce a given output from given equipment. Two points stand out. First, in some sectors a more labour-intensive method of production is economically more efficient than current methods. This may, in turn, imply the need for more, not less, skilled labour and vocational training. Second, if the technology and output are taken as given the bulk of studies show that more and less skilled labour are substitutes, rather than complements in the production process. It would be illuminating to know if this is also true in the particular plants where training associated with Bank projects takes place.

Firm-level (Section 5) training studies are quite rare, but the economic analysis they contain is, in general, outstanding. Much World Bank training is also firm-related training so these firm studies provide particularly helpful guidance. On the cost side it is clear that the costs of informal training are difficult to get at, while foregone earnings and the resources devoted by the firm to formal training are more easily estimated. But it is on the benefits side that the real insights are gained. First, sophisticated production functions are unlikely to be able to pick up any relationship between trained labour and output at the level of the firm. Second, performance ratings are a sensible and useful method of measuring (individual) productivity and would be helpful in cost effectiveness studies of World Bank training expenditure. Third, downtime is a potentially valuable intermediate measure of output. Fourth, and most important, pay may well be an imperfect indicator of value product, in particular pay rises with experience but productivity may not. Therefore if we use pay to measure the value of output a cost-benefit framework may not always give correct results.

It is noteworthy that firm-level studies typically concentrate on either costs or outcomes but do not analyse both simultaneously in the form of cost-benefit analysis. (By contrast, rate of return studies abound for public training programmes). There are a number of reasons why there are few rate of return studies to corporate training. First, training is not usually a separate entity which must show a profit. Second, it is difficult to disaggregate training from other things that go on inside a company - training is part of a whole bundle of things that go on together. Third, it is very difficult to test for the notion of specific training, where training is only useful in the firm providing it. Firm specific training is tied up with implicit contracts and monopsony power. Much firm-level training (either on-the-job or off-the-job in the firm or in institutions) is concerned with encouraging loyalty and the promotion of an internal labour market. It is plausible that such company training is simply not testable in standard cost-benefit terms. In particular, is it really possible to estimate the wedge between value product and pay?

Despite such problems Part II concerns methods to evaluate the external efficiency of vocational training. In Section 6 we discuss how to evaluate such training using earnings data and the problems which occur. This section draws, in particular, on the illumination provided by the firm-based studies and the extensive literature on the evaluation of public manpower and training programmes. Methods and objectives are discussed first. Then various technical problems are elaborated, including: sample size, control groups, the use of longitudinal data and problems caused by labour mobility. Finally the relationship between earnings and value product is extensively analysed. In general non-competitive labour markets, externalities and disequilibrium drive a wedge between earnings and the true worth of the individual to the firm so great care must be taken when evaluating the corporate and social rate of return to vocational training.

Section 7 discusses cost-effective and cost-benefit analyses of vocational training using output and input data. A number of promising output and input measures exist. For example a before/after study could be based on the output of particular individuals and use piece-work earnings, performance rating or quit propensity as the indicator of output. Or training might be analysed at the plant level using plant downtime or the value of production as the output measures or reductions in labour and other factors as the input measure associated with training.

PART I

VOCATIONAL TRAINING IN DEVELOPING AND INDUSTRIAL COUNTRIES, SUBSTITUTION AND FIRM BASED STUDIES

SECTION 2

The Payoff to Vocational Training in Developing Countries: A Review of the Evidence

2.1 Introduction

A limited number of studies have examined the rate of return to vocational training in developing countries. A number of overlapping but different themes are apparent in the partial survey which follows. These include:

- the case for expansion of the system of vocational training or particular parts of that system,
- the internal efficiency or cost effectiveness of the system, for example between different types of courses or different length courses,
- comparisons of the payoff to on the job training and off the job training, though "on" and "off" need careful definition,
- the substitutability between vocational training and formal schooling,
- the vocational school fallacy.

These themes will be examined one at a time below.

The studies run up against many technical problems of evaluation, particularly, on the benefits side. These problems include:

- the type of control group: full longitudinal data are helpful because we are then dealing with the same individuals before and after training. Where we only have cross section data the control variables may be crucial,
- the measurement of earnings is important on both the cost and benefit side, for example: do earnings reflect productivity, what do we do about intangibles, is the labour market in equilibrium, what is the shadow price of labour?
- mobility of individuals among firms, occupations and countries influences the various rate of return calculations to individuals, firms and society,

- is it possible for a firm to drive a wedge between pay and productivity for long periods? This is particularly important in calculating the rate of return for the firm,
- the need to correct cost and benefit figures for drop-outs,
- the extent to which wider labour market analysis - of vacancy rates and earnings changes for example - is useful to supplement the rate of return analysis.

Such methodological problems will only be briefly examined here, but they are more fully discussed in Part II.

To set the scene the results of the various studies are summarised in Tables 2.1 and 2.2. In Malaysia Cohen (1983) examined three types of training - two year basic, job entry training for new recruits and apprenticeships - which all apparently yield a high rate of return, of the order of 20 per cent. Borus (1977) was particuarly interested in the cost effectiveness of four different modes of vocational training in Israel. He concluded that the different modes yield the same earnings even though they have very different costs. In particular he questioned the cost effectiveness of formal vocational secondary schools. However, his results have been qualified somewhat by Levine (1979).

Two studies which do not measure productivity by earnings are those of Fuller (1976) and Godfrey (1977). Fuller finds that productivity in his Indian case study firm is raised more by in-firm training than by pre-employment vocational training institutes. His study is unusual because productivity is measured by a cardinal scale of worker efficiency ratings. In a rare study relating to Africa Godfrey (1977) examines whether the likelihood of passing a government trade test (at three different levels) of craft skills is related to institutional training, after controlling for schooling and age. He finds

TABLE 2.1

Payoff to vocational training in Asia and Africa

Country/ author	Type of training	Rate of return (%) or regression coefficient		Method	Other control variables	Sample
Malaysia		Rate of return				
Cohen (1983)	2 year basic (equivalent to apprenticeship)	Firm 22, Private 27, Social 25		Benefit/cost using constructed longitudinal data	When relevant includes retention rate post training	10 firms in 8 sectors, 1982 2809 total trainees 16633 total workers
	Job entry for new recruits	Firm 46				
	Apprenticeships					
	Institutions (I) cf. Firm (F)	Private: F15, I15 Social: F21, I19 Firm: F21, I61				
Israel						
Borus (1977)	Comparison of following modes of vocational training (length of course, years)	Benefit: earnings over VSS (IS£ 1969)	Social cost (IS£ 1972)	Cross section regression (benefits)	Sector: metal, electrical, automobile Immigrant status Age (1947 cohort) Sex (men)	530 individuals in metal, electrical and automobile sectors, 1969, 1970
	Apprenticeship (3)	-79 (ns)	3075			
	Industrial school (3)	1260 (ns)	16825			
	Short course (1)	31 (ns)	15600			
	Vocational secondary school (4)	-	26750			
Levine (1979)	Vocational secondary schools compared with:	Rate of return Social	 Private	Cross section regression (benefits), correcting Borus	As above	As above
	Apprenticeships	3	3			
	Industrial school	8	6			
	Short course	7	13			
India						
Fuller (1976)	Comparison of following modes of vocational training	Benefit: job performance over P-E	Social cost rupees discounted at 10%	Cross section regression	Education, training duration, SES, religion, cast, location, job aspirations, job satisfaction	474 turners, millers and grinders, in one factory, South India
	Pre-employment (P-E)	-	7580			
	Organised in-firm	9	4550			
	Informal in-firm	10	0			
Kenya						
Godfrey (1977)	Full-time vocational in institutions	18% less likely to pass government craft test		Cross section regression	Education, age	446 (440 men, 6 women) candidates, 1973, Nairobi, Kisumu

TABLE 2.2

Payoff to vocational training in South America

Country/ author	Type of training	Rate of return or regression coefficient		Method	Other control variables	Sample
Brazil						
Castro (1979)	SENAI	SENAI after:	Social %			
		primary school	24	Benefit/cost using cross section earnings data	Age	Sao Paulo, Rio de Janeiro manufacturing sector, large firms 1970
		junior high school	12			
		high school	23			
Chile						
World Bank (1965)	INACAP		Social %	Benefit/cost	None	Country wide averages 1965
		Unskilled to semi-skilled Semi-skilled to skilled Specialised	50			
Arriagazzi (1972)	INACAP	As above, correcting for: completions, promotions, employment prospects, wage increases, ability factors	20	Benefit/cost	See corrections listed	Country wide averages 1965
Colombia						
Puryear (1979)	SENA 3 year apprenticeship		SENA earnings increment %	Earnings function	Formal education Work experience Firm size Father's economic status	Bogota SENA graduates (1965, 1967) and others Scmple 1972, n = 439
		All	48			
		5-6 years formal education	76			
		7-11 years formal education	31			
Peru						
Psacharopoulos (1982)	SENATI	Pay differential required for 10% social rate of return as % of minimum wage		Inverted Benefit/cost	None	6 firms in Lima area 1982
		Anorenticeship (2 years)	72			
		Short courses (few weeks)				
		In service upgrading	0.5			
		Training within industry	1.15			

those with some full time institutional training have lower pass-rates than those with no such training. Both these studies cast doubt on the payoff to institutional vocational training even though they do not calculate social or private rates of return.

The payoff to vocational training in South America is summarised in Table 2.2. The systems in the countries described in the table seem quite similar. The training organisations are semi-autonomous. They are financed by a payroll tax on private firms above a certain size and on all public organisations. The system is separate from the formal education system and consists mainly of vocational schools or in-plant but off the job training. The ILO provides technical assistance.

In Brazil postgraduate SENAI training yields a minimum social rate of return of 12 per cent (Castro, 1979). One of the earliest internal World Bank rate of return studies showed a social rate of return to the INACAP training system in Chile as high as 50 per cent, but various qualifications by Arriazazzi (1972) cut that exceptionally high figure by over half to some 20 per cent. For Colombia Puryear (1979) shows that individuals who have taken a three year SENA apprenticeship earn, on average, nearly half as much again as similar individuals who have not been exposed to SENA, and the SENA-effect is bigger for those with less formal education than those with more eduation. These studies of training in Brazil, Chile and Colombia all show a rather high payoff to vocational training, but the opposite conclusion was reached by Psacharopoulos (1982) in the analysis of SENATI training in Peru. There were no data to calculate a rate of return, therefore the author inverted the problem and calculated the pay differential trainees would require to generate a 10 per cent social return. Individuals trained under two year apprenticeships would require, post training, a positive differential over 70 per cent above the minimum wage and the study questions whether this would be forthcoming, although it is more sanguine about the prospects for shorter courses.

2.2 The case for expansion of vocational training

The World Bank has undertaken studies designed to see whether the whole system of vocational training should be expanded in a particular country and whether particular components should be expanded faster than others.

Twenty years ago a lucid Bank study (Picciotto 1965) examined the case for large-scale expansion of vocational training to be undertaken by the National Training Institute (INACAP) in Chile. The project concerned three specific INACAP programmes (Arriagazzi, 1972):

- Basic training courses to upgrade unskilled into semi-skilled workers. These full-time courses lasted three to six months and covered a variety of trades. They were designed especially for: youngsters who had reached a prescribed minimum of general education but with no technical training, unemployed people, employed workers wishing to change jobs or to migrate to another area.

- Further training courses to upgrade semi-skilled workers to skilled status. These evening courses, lasting from ten to twenty weeks covered a variety of trades and were intended mainly for experienced workers with daytime jobs.

- Specialisation courses to provide experienced skilled workers with more advanced special skills. These evening courses lasted from five to fifteen weeks.

In 1965 some 12,000 trainees had completed these INACAP programmes. The proposed target was to expand the annual output of the three programmes by an additional 14,000 trainees. The Bank estimated the project costs - capital, current, ILO technical assistance and students' foregone earnings. Benefits were defined as the total extra gross earnings the 14,000 trainees could expect to receive on completion of their period of training adjusted downwards, in aggregate, arbitrarily by one third to allow for the fact that a fraction of the employees might, in time, have acquired equal proficiency simply with experience. The internal rate of return on the project was put at 50 per cent, providing "ample economic justification for undertaking the project" (p.4). The costs and benefits of this project were re-calculated by Arriagazzi (1972). The revised costs changed little but more conservative figures were used for benefits. The 1965 study had assumed that:

- all trainees would complete their course,
- all trainees would get promoted accordingly,
- following training, individuals would be fully employed for twenty years,
- each worker's increased earnings would begin as soon as the second year after his training,
- the present value of earnings should be reduced by one sixth to allow for a reduction in the work week from six to five days,
- the present value of earnings should also be reduced by one sixth to allow for the fact that some trained workers would eventually acquire similar skills via experience.

More realistic assumptions cut the social rate of return to around 20 per cent, still "strikingly high" (p.358).

The economic justification of expanding vocational training facilities in Peru has recently been analysed by Psacharopoulos (1982). SENATI is the national centre for industrial training, financed by a 1.5 per cent payroll levy of firms employing more than 15 employees. Essentially it runs two types of programmes:

- long term apprenticeships (about two years duration) offered to youths with secondary school background via full-time SENATI based instruction
- short term upgrading courses (of a few weeks duration) offered to adult employed workers by means of a visiting instructor in the firms.

No full data on earnings of SENATI graduates and others exist and so rate of return calculations were not possible. Therefore the problem was inverted and the earnings differential due to SENATI training required to produce a social rate of return of 10 per cent was estimated. The earnings differential is arrived at by solving the short cut rate of return formula for the numerator of the expression:

$$\frac{\text{Required earnings differential}}{\text{Training cost (= unit cost plus foregone earnings)}} = .10$$

The results are given in Table 2.3. As the study remarks, there is a "dramatic difference ... between apprenticeship and other programmes offered by SENATI. Productivity differentials equivalent to 0.3 to 5.0 per cent of the minimum wage rate can be reasonably assumed to exist for short term programmes like In-Service Upgrading and Training within Industry. The 50,353 sales monthly differential associated with apprenticeship is rather unlikely to exist in practice". Therefore the study, conservatively, recommends that in any expansion of the SENATI system priority should be given to the shorter courses.

The World Bank has recently also examined the cost for expanded in-service industrial training in Malaysia (Cohen 1983). Malaysia lags significantly behind other major Asian countries in terms of technical/vocational school

TABLE 2.3

SENATI programme in Peru

Type of programme	Unit cost per participant 1982 soles	Monthly productivity (earnings) differential to yield 10 per cent social rate of return	
		in absolute 1982 soles	as per cent of the minimum wage rate
Apprenticeships	4,362,400	50,353	71.9
In-service upgrading (PTS)	38,000	320	0.5
Training within industry (ADE)	127,400	1,058	1.5
Support to small industry	193,700	1,614	2.3
Mobile units	273,900	2,283	3.3
Instructor training	429,800	3,582	5.1
Tele-education	22,500	188	0.3

Source: Psacharopoulos (1982), Tables 2.2, 2.3.

Notes: Unit costs include direct costs and administrative expenditures. It has been assumed that apprenticeships last two years and instructor training one year. Foregone earnings are not given, but it is straightforward to calculate them from the formula given on page 21.

enrollment as a percentage of total school enrollment (Malaysia - 11 per cent, Republic of Korea - 50 per cent, Thailand - 26 per cent). The study indicates that "rapid industrialisation over the past decade has not been matched by the necessary restructuring of the education system to increase emphasis on technical and vocational training. The shortfall in this type of training may, however, be too large to be resolved solely by the expansion of institutional training. Although institutional training is indispensable in the longer run, training by industry will have to play a greater role in reducing the imbalance in the short term" (p.1).

The sample was drawn from ten companies, ranging in size from 340 to 4,300 workers. About 17 per cent of the total workers in the ten companies were undergoing various types of training. Of these about 96 per cent were enrolled in in-house training and the remainder in out-of-house training. There are four types of training:

- basic training for new recruits for about two years partly on the job and partly off the job, equivalent to apprenticeship training,
- job entry training for new recruits on probation for a shorter period, usually six months,
- refresher courses for the company personnel lasting from a few days to a few weeks. Pay is not affected,
- upgrading courses for company personnel for a few weeks, partly on and off the job. On completion their salary is rescaled.

The study concentrates on the first two types of training and it also presents comparisons of the payoff to on-the-job and off-the-job training.

Returns to the individual, the firm and society from basic skill training are given in Table 2.4. The relevant formulae for calculating the rates of return are discussed in Section 5. The private and social returns

TABLE 2.4

Returns to basic skill training, Malaysia, 1982

Sector	Rate of return (%) to:		
	Firm	Worker	Society
Metal products	29	28	29
Non-electric machinery			
Firm A	13	29	14
Firm B	22	24	22
Firm C	25	25	35
Average	22	27	25

Source: Cohen (1983), Tables 2.4, 2.6, 2.7.

are well known. The rate of return to the firm is a less widely used notion. The costs to the firm are: cost of training plus earnings of trainee minus the productive value of the trainee. The benefits to the firm are: the productive value of the worker minus the earnings paid to the worker, all multiplied by the retention rate of trained workers. The rates of return set out in Table 2.4 suggest that this is an attractive investment from each of the three different perspectives. Likewise, the rate of return to the firm from job entry training averages 46 per cent. However, these results should be treated cautiously. A before/after methodology was used. Although this is ingenious it is also worrying because the study simply constructs the required longitudinal data. In particular, it assumes that the productive value of the worker post training is equivalent to the average earnings of a trained worker but that actual earnings are below average earnings for twenty years post training. This "automatically" produces a high rate of return to the firm and to society. This problem is discussed further below (Section 6) but it is worth remarking here that it is not clear how the firm is able to pay the trained worker below his true worth for as long as twenty years.

For apprenticeship training the study is able to estimate and compare returns to institutional training (IT) and firm training (FT). The main differences between them are:

- the firm gives a premium of 12 per cent higher pay to an IT trained apprentice, largely attributable to his additional productive capability over company workers,
- the retention rate of IT graduates is 10 per cent below FT workers,
- the production during training is lower among trainees from IT than among company trainees, by about 25 per cent,
- the training costs of IT are higher than those of FT. The average unit cost for IT is M$ 7,570, compared to M$ 5,200 for the cost of FT.

The resulting rates of return are as follows (%):

	Individual	Firm	Society
Firm Training	15	21	21
Institutional Training	15	60	19

The economic return is again very high, suggesting the proposed expansion of vocational training is sensible. The payoff to the firm is higher from recruiting an IT worker than from undertaking its own training. This is because the firm does not bear the cost of IT and hints that a levy/grant system might help equalise the FT and IT returns to the firm.

2.3 Cost effectiveness of vocational training

Vocational secondary school programmes are costly, therefore we must ask "Does vocational schooling result in sufficiently superior job performance and earnings to justify the extra cost?" (Staley, 1971). Studies which confront this cost-effectiveness question include those for Israel (Borus, 1977) and India (Fuller, 1976). The economic returns in the early 1970s associated with the costs of four different types of vocational training in Israel - vocational secondary schools, industrial schools, apprenticeships and short courses - are examined. The results of Borus' study have been scrutinised by Levine (1979). The vocational programmes in Israel were described by Borus as follows in 1972-3:

Apprenticeships

The apprenticeship programme had 8,600 enrollees. The majority were for three years. Typically apprentices came from low socio-economic backgrounds. The apprentices work five days a week with employers providing on-the-job training and they attend school one day a week to learn the theory of their trade. Apprentices were examined at the end of each year and had to pass an examination before receiving Ministry of Labour certification necessary to work in their trade.

Industrial schools

Some 1,800 students attended about thirty industrial schools in 1972-73. These schools, operated in co-operation with and at the site of large employers of skilled labour, combined regular vocational secondary school training with in-plant training. The courses typically last three years. At the end of their training the students were examined and certified in their trades by the Ministry of Labour.

Ministry of Labour "short" courses for youth

Some 2,100 16- and 17-year olds participated in short courses sponsored by the Ministry of Labour. Many of these were preludes to further training or work within the Army and usually lasted for one year. Most of the time was devoted to providing practical experience in the trade. At the end of their courses the students were tested and certified in their trades by the Ministry of Labour.

Vocational secondary schools

Some 70,000 students, or 50 per cent of secondary school students, attended vocational secondary schools. These schools were highly selective, admitting only the better primary school students. Approximately half the week was devoted to general studies and half to practical training in vocational subjects.

The data for the study refer to the 1969 and 1970 earnings of 530 individuals born in 1947 who were trained in one of the three occupations - automobile mechanics, electrician trades, metal working trades. Earnings were regressed on type of vocational training, sector and immigrant status. Some results are given in Table 2.5. There are no significant differences in earnings among the four training modes or, as Borus puts it "the different modes of training yielded approximately equal products" (p.9). However the training costs are very different. Table 2.6 indicates that the cost per student is five times higher for Industrial Schools and Short Courses than for Apprenticeships and that Vocational Secondary Schools are nine times as costly as Apprenticeships.

These findings suggest that, focussing on skills training, the formal vocational secondary schools, are much less cost effective than other methods of training skilled and semi-skilled workers, particularly apprenticeships. However, Levine (1979) suggests that these results must be qualified. He points out that, in general, individuals with the most years of formal education also undertake more on the job training than other workers. Borus is observing earnings only a few years after one or other of the training modes. Thus, while the earnings for the 1947 cohort from the four training modes are not significantly different from one another in 1969 or 1970 the present values could be different if we had more complete data on longitudinal earnings, because those going to vocational secondary schools may have steeper age-earnings profiles. Levine re-works Borus' data using plausible assumptions about (i) the fraction of potential earnings invested in each period, and (ii) the return on that investment. In turn, this permits a rate of return calculation to the extra investment in vocational secondary schools over and above the other training modes. The results are given in Table 2.7. It seems clear that the payoff to the extra resources devoted to vocational

TABLE 2.5

Regression of 1969 and 1970 earnings (in Israeli Lirot) on four training modes by occupation and immigrant status (n = 530)

Independent variables	Sample distribution	1969 Earnings regression coefficient	1970 Earnings regression coefficient
Constant		5471	4688
Metal			
Industrial school	.03	1290	1479
Vocational secondary school	.18	-39	-74
Electrical			
Apprenticeship	.05	-1934	-521
Vocational secondary school	.16	-259	-833
Automobile			
Apprenticeship	.14	-105	-374
Short course	.04	-334	-351
Vocational secondary school	.03	-1744	-188
Immigrant	.64	-19	-197

Source: Borus (1977)

Notes: (i) All coefficients non-significant at 5%; $\bar{R}^2 = .00$.
(ii) Intercept value: Israeli born apprentices in metal trades.

TABLE 2.6

Approximate average cost (in Israeli Lirot) per student enrolled in various types of vocational training in 1972-73

Cost	Apprenticeship (3 year)	Industrial school (3 year)	Short course (1 year)	Vocational secondary school (4 year)
Instruction, administration, equipment, building	3075	9250	3825	11050
Student opportunity cost	0	7575	11775	15700
Total cost per student	3075	16825	15600	26750

Source: Borus (1977)

TABLE 2.7

Estimated rate of return in Israel to investment in vocational secondary schools, over and above other training modes listed

Comparison Group	Return to vocational secondary schools (%)			
	Social rate of return		Private rate of return	
	Minimum	Maximum	Minimum	Maximum
Apprenticeship	0	5	0	5
Industrial school	2	14	0	11
Short course	1	12	4	21

Source: Levine (1979)

secondary schools over apprenticeships is not worthwhile for individuals or for society (from the perspective of skill-training) but it just might be as compared with the Industrial School and Short Course mode.

Recently Ziderman (nd) has up-dated the work of Borus and Levine using individual earnings data for the 7-year period 1969-75 for two samples. One sample consisted of some 300 graduates of Ministry of Labour vocational courses for adults, and the other of 1,500 skilled workers who received their training as teenagers either at vocational secondary schools or at industrial schools, short annual teenager courses or apprenticeships. The samples were standardised by age, location and background data on the individuals. Ziderman found no significant differences in the earnings of graduates of the four types of courses. This confirms the earlier results of Borus relating to a much shorter post-training earnings follow-up. They also confirm the Borus-Levine results that the expensive vocational secondary schools offer no earnings advantage, even in the longer term, over cheaper job-related training programmes. Ziderman concludes "Here it would seem is yet a further instance of the vocational schooling fallacy" (p.135). Ziderman also found that workers undergoing training in their early and mid twenties may expect a higher lifetime earnings profile than teenage trainees, a result of the benefits stemming from the continuity of study and work experience uninterrupted by army service and also a reflection of the better career choices made at a more mature age.

Fuller (1976) studies the cost-effectiveness of different types of vocational training in one large plant in southern India. His productivity measure was the job performance, as assessed by their supervisors, of 474 millers, turners and grinders. The advantage of using efficiency rating is that "they are related specifically to a worker's individual output (quality and quantity) and already take into account extraneous factors affecting worker performance such as machine capacity, flow of materials from co-workers, ease of access to tools and instruments, and hardness of raw materials" (p.31).

There were three mutually exclusive training paths:

- Industrial Training Institutes (ITI), an eighteen month government sponsored vocational programme for boys with some secondary schooling, sometimes followed by one year pre-employment apprenticeship training (n = 214),
- In-Firm Training (IFT), any organised training programme operated within the company for employed workers (n = 227),
- Picking Up Trade (PUT), where unskilled workers acquire job know-how by imitations, co-workers and supervisors (n = 33).

Control variables included schooling, experience, caste, religion and job satisfaction. The benefits and costs of the three types of vocational training are given in Table 2.8. For the whole sample job performance is around ten per cent higher among those formally or informally trained in-plant than in the Industrial Training Institutes. Yet the costs of institutional training are much higher. Clearly, in the case of this particular firm at least, the Industrial Training Institutes are not cost effective.

TABLE 2.8

Benefits and costs associated with three modes of vocational training in one plant in southern India

Type of training	Costs discounted at 5% (rupees)	Costs discounted at 5% (rupees)	Job performance % over pre-employment		
			All sample	Medium education	High education
Pre-employment	7580	6824	-	-	-
Organized in-firm	4550	4345	9	8	6
Informal in-firm	0	0	10	0	19

Source: Fuller (1976), Tables 3, 4, 5.

2.4 Social rate of return to different modes of vocational training

Naturally it is interesting to widen the cost-effectiveness question and to enquire whether a particular mode of vocational training has a consistently higher payoff than another mode. Some such comparisons are presented, tentatively, in Table 2.9. Most of the studies surveyed are surprisingly vague on the precise nature of the vocational training they are analysing, therefore the classification is speculative. The table suggests the following points.

First, of the thirteen country/mode cells in the table nine seem to have acceptably high social rates of return. The exceptions are: (i) SENATI apprenticeships in Peru; (ii) Vocational Secondary Schools in Israel if they were to yield only the minimum rate of return; (iii) Industrial Training Institutes in India, and (iv) Full time institutional craft training in Kenya.

Second, on the costs side, when we compare different modes of training inside a given country the social rate of return is higher where training expenditures are low and where foregone earnings are small or zero. (Although this is not surprising it need not be so). For example in Israel in-plant apprenticeship training has a higher payoff than formal vocational secondary school training. An in Brazil and Peru short in-plant training has a larger social rate of return than institutional training done through SENAI and INACAP (though we should, presumably, treat some of the Brazilian estimates of rate of return to in-plant training rather cautiously). In India the Industrial Training Institutes have substantially higher costs, and a lower impact on productivity, than in-firm training. Such cost differentials bring out the importance of the internal efficiency of training.

TABLE 2.9

Social rate of return (%) to different modes of vocational training

Country	Apprenticeships classroom and on-the-job	Institutional	In-plant workshop but not on-the-job	On-the-job i.e. production process
ASIA/AFRICA				
Malaysia (Cohen 1983)	2 year basic skill training 21-25	For apprenticeship 19		
Israel (Levine 1979)		To Vocational secondary schools cf. apprenticeship 0-5 industrial school 2-14 short courses 1-12		
India (Fuller 1976)		Productivity 9% worse than in-firm training and costs higher	Productivity 9% better than institutional and costs lower	Productivity 10% better than institutional and costs zero
Kenya (Godfrey 1977)		14-25% less likely to pass government craft test than those with no such training		
SOUTH AMERICA				
Peru (Psacharopoulos 1982)	2 year SENATI low return		Short SENATI courses high return	
Chile (Arriagazzi 1972)		INACAP max 6 months 20		
Colombia (Puryear 1979)	3 year SENA earnings effect 48 N.B. NOT social rate of return			
Brazil (Castro 1979)		SENAI over primary 39	SENAI or own firm over primary and junior high 243	

In Kenya government trade tests are conducted in many craft trades, including engineering, woodwork, building, electrical trades, tailoring trades. There are three grades of trade test. It is possible to prepare for the test by attending a full time course at a training institution. In Godfrey's analysis of the pass/fail rates in these tests 141 out of 446 candidates had attended such a full time course, at institutions ranging from village polytechnics and youth centres at one extreme to the Kenya Polytechnic at the other. After controlling for schooling and age those who have followed such institutional vocational training are significantly less likely to pass the trade test than those without training: those taking the (easiest) Grade III test are 14 per cent less likely to pass and those sitting the (hardest) Grade I test are 25 per cent less likely to pass. This raises serious doubts about the social rate of return to such institutional training in Kenya.

Third, one country where explicit comparisons of different modes of training were made was Malaysia. Apprenticeship training via a mixture of on-the-job training and classroom training has a somewhat higher social return than purely institutional apprenticeship training.

Last, but not least, wherever comparisons are possible within a country we note that institutional vocational training always has a lower payoff than training done wholly or partly inside the firm, whether on or off the job.

2.5 Relationship between formal schooling and vocational training

Two of the studies of vocational training in South America have examined the relationship between formal schooling and vocational training. Puryear (1979) estimated the payoff to three year SENA apprenticeships in Colombia. His sample consisted of all males who had graduated from the SENA industrial apprenticeship programme in Bogota between 1965 and 1967 and, essentially, a control group of Bogota men similar to the SENA apprentices in age and formal education. He regressed the hourly earnings of his sample in 1972 (i.e. five to seven years after training) on: whether a SENA graduate, years of formal schooling (squared), years of work experience, firm size, father's socio-economic status. SENA graduates earn, over the sample as a whole, 48 per cent more than equivalent non-SENA graduates, but this "SENA effect" is smaller for those with more than six years education. Those with only primary school education gain 76 per cent in hourly earnings if they are a SENA graduate, while those with ten or eleven years formal education gain only 33 per cent (Table 2.10). Puryear notes that this implies SENA can substitute for formal education. We can make this more concrete as follows. The coefficient on years of formal schooling (squared) is 0.005, therefore SENA graduates with eleven years formal education get only 5 per cent more earnings than those with five years.:

	Individual with 5 years education	Individual with 11 years education	Gain associated with extra years of education
SENA	.760	.330	-.430
Formal education	.125 (= .005 x 5^2)	.605 (= .005 x 11^2)	+.480
			NET +.050

TABLE 2.10

Impact of SENA on hourly earnings in Colombia, 1972, by years of education

Years of formal education	All sample	5, 6	7, 8, 9	10, 11
3 year SENA apprentice graduate, impact on hourly earnings (%)	48	76	29	33

Source: Puryear (1979), Tables 1 and 2.

Such a result confirms Puryear's observation that SENA can substitute for extra years of formal education.

In his analysis of SENAI vocational education in Brazil, Castro (1979) comes to a rather similar conclusion. He calculated rates of return for manual workers with various combinations of education and training in the manufacturing sector in Sao Paulo and Rio de Janeiro. The results for Sao Paulo are reported in Table 2.11. The social rate of return to the SENAI programme is higher (24 per cent on average) for those with only primary education than those with junior high school education (12 per cent on average). Likewise the social return in both Rio de Janeiro and in Sao Paulo to those going on to four years of junior high school after primary is only half that (12 per cent) of those who instead go on to the SENAI programme (24 per cent).

Formal education and vocational training each separately add to earnings in Brazil and Colombia. The social returns to extra formal education appear high in both countries: the return to high school in Brazil is twice the return to junior high school, and in Colombia years of education are associated with earnings not linearly but quadratically. However, for our purposes the dominant result is the very high payoff to quasi-institutional vocational training for those who have only completed primary school, which suggests that such vocational training may be substitutable for extra formal schooling.

Fuller's (1976) case study from India also distinguishes various combinations of schooling and training. Irrespective of schooling level workers formally trained in-firm perform better than those trained in the vocational institute. For those who picked up the trade informally the productivity

TABLE 2.11

Social rates of return by type of vocational training and level of academic schooling, Sao Paulo 1970

Level and type of education		Social rate of return %
1. Junior high school after primary school		12
2. High school after junior high school		23
3. Technical high school after junior high school		13
Draughtsman	12	
Electricity	30	
Electronics	0	
Mechanics	31	
Metallurgy	9	
Chemistry	9	
4. SENAI after primary school (4 to 6 years)		24
Draughtsman	9	
Electricity	37	
Electronics	18	
Tool and die making	46	
Mechanics	33	
Metallurgy	24	
5. SENAI after junior high school		12
Mechanics	26	
Production control etc.	8	
Research and development etc.	29	
6. SENAI after high school		23
Mechanics	39	
Production control etc.	20	
Research and development etc.	43	

Source: Castro Moura (1979), Table 1.

effect, relative to institutional training, only occurs for those with high levels of schooling suggesting extra schooling may be a pre-requisite for on-the-job training.

2.6 The "vocational school fallacy"

The studies discussed above provide some evidence on the so-called "vocational school fallacy" Foster, 1966). Different authors interpret this fallacy in different ways. One strand is to examine the returns to vocational training in institutions as compared with that on or off the job in firms. Another concerns the relative merits of vocational training in institutions compared with longer academic schooling coupled with on-the-job training.

In South America the returns to the various institutional training agencies in Chile, Colombia and Brazil suggest that the vocational schools there are cost effective particularly for those with relatively low levels of formal primary and/or secondary schooling. Thus Castro describes the SENAI system in Brazil as "one of the most successful experiments in the history of Brazilian education" (p.618) which "revealed outstanding results for vocational education, as compared with academic education plus on-the-job training" (p.622). Such a strong view may need to be questioned in the light of evidence presented by Miller and Zaidi (1981). They studied the factors associated with earnings in multinational companies in Brazil and Mexico in the auto and retail sectors (n = 1137). There was no evidence that current earnings were associated with formal training either in previous jobs or in current job. By contrast earnings were associated with years of education and current job tenure, which they interpreted as a payoff to on the job training. Possibly multinationals insist on a mode of vocational training different to that supplied by SENAI.

The studies relating to India, Israel and Kenya all tend to support the vocational school fallacy. In Israel formal Vocational Secondary Schools have higher costs than other modes of vocational training and may not yield correspondingly higher earnings. Levine suggests that the Vocational Secondary Schools may just about yield a tolerable social rate of return over Industrial Schools and Short Courses but his figures confirm that apprenticeships are the most cost effective training device. Likewise in India the Industrial Training Institutes have higher costs and a lower productivity-raising effect than formal or informal in-firm training. Further the productivity effect of informal training is highest for those with the most education (though whether it is sufficiently high to justify the extra schooling cannot be calculated from Fuller's data). And in Kenya Godfrey concludes thus: " ... the fact that those who have undergone full-time training courses do worse at all grades of test than those who have not suggests at least that the efficacy of such courses and of the institutions which house them needs to be carefully examined" (p.35).

In the most thorough study so far Psacharopoulos and Loxley (1984) contrast the educational and labour market attainments of graduates from academic and vocational schools and schools with different biases in Colombia and Tanzania. Costs and outcomes are related in order to get at the external efficiency of the respective schools. Outcomes include learning achievement, ability among secondary school leavers to achieve further education and training, and ultimately to perform in the labour market. The primary explicit rationale for diversified secondary schooling and the introduction of vocational or pre-vocational studies, such as industrial arts or agriculture, has been to increase the economic relevance of schooling. Therefore it is labour market achievement, rather than increases in learning achievement or changes in attitudes, which is the most important outcome. The evidence of this outcome is tentative because not all the sample of secondary school leavers surveyed had entered the labour market by the time of the survey. A number of hypotheses were examined. For example it was suggested that diversification (i.e. vocational as well as academic schooling) leads to:

- less private demand for post-secondary school
- a closer relationship between school bias and specialisation of post-school training
- a higher propensity for labour force participation at the end of secondary schooling
- employment in the field of pre-vocational specialisation
- shorter periods of unemployment (job search) following secondary school graduation, and
- higher graduate earnings

In general, the evidence does not support these hypotheses. In particular, in Colombia there is no statistically significant difference, other things equal, between mean earnings of those on the two different track and in Tanzania the "first indications do not corroborate the hypothesis that the introduction of pre-vocational studies into secondary schooling can be justified on the basis of the economic payoff being greater than for academic schooling" (p.7-30). The preliminary results of this thorough study therefore also support the vocational school fallacy.

2.7 Summary

It is difficult to generalise on the basis of the studies examined in this section because there is no guarantee that the results would be replicated over time or across countries. Nevertheless, some tentative conclusions are possible. First, where the rationale for the study was to see if any expansion in training facilities was justified the rate of return was typically high enough to justify such an expansion. Second, there is some evidence that in Brazil and Peru short courses have a bigger payoff than longer courses of training. Third, training in industrial institutes and vocational secondary schools is less cost effective than more informal firm-based training, at least in Kenya, India and Israel. Fourth, the payoff to quasi-institutional vocational training in South America is higher for those who have only completed primary school than for those who have completed secondary school. This suggests that extra formal schooling may be substitutable for formal institutional vocational training.

SECTION 3

Public training programmes in industrial countries

Most governments provide funds for public provision of training places. In addition they often intervene in an attempt to improve the way the private training market works. In this section we examine some such government activities in Britain and the US in order to provide insights into training evaluation problems in developing countries.

Most recent evaluation work in the US has concerned the private gains to participants in MDTA or CETA. These evaluations demonstrate the importance of longitudinal data (i.e. before and after training) and comparison groups (i.e. trainees and a control group). Evaluations which are based on simple cross section data or which do not have a control group are likely to be misleading. Further, it is shown that placement rates are a poor performance indicator of prime sponsors' training efforts.

In Britain the state provides limited training facilities for adults, many of whom come to the training place from employment rather than unemployment. Evaluations of such state provision are discussed. It is frequently asserted that the quantity and quality of training is deficient in Britain as compared with that in other European countries. Three sorts of market failure - externalities, imperfect capital markets and labour market monopoly - which could be responsible for this deficiency are discussed.

3.1 US public training programmes

There are a number of good surveys which evaluate the impact of US manpower programmes (e.g. Borus 1972, Bloch 1979) therefore an extensive survey of this literature would be gratuitous. Instead, it is worth focussing on the great difficulty in correctly evaluating public training. Most studies simply have not made all the necessary controls (including the British studies surveyed below) and it is likely that earlier rate of return estimates are awry (see Bassi 1983, 1984 for a clear technical discussion of the statistical problems, with an application to CETA).

We focus on individual (i.e. private) returns to CETA training, and its predecessor MDTA. The major difficulty in estimating the impact of training (or education) on earnings is selection bias, sometimes called population heterogeneity. In the absence of an experimental design where individuals are randomly assigned between groups, it is likely that the decision to participate in the training programme, or the selection process, is highly correlated with unobservable factors which also help determine earnings. This can result in the impact of training being either overestimated or underestimated. For example, individuals may self-select into CETA or are selected by administrators on the basis of innate ability or intelligence - on which there is no data. If very able individuals are selected onto the training programme, the payoff to training will be overestimated. Assuming that this individual characteristic - innate ability - is constant over time the statistical problem can be overcome by what is known as a *fixed effects* model. What this does is take an earnings function prior to training and an earnings function post training and difference them, thus causing the unobserved innate ability to drop out and leaving the *change* in earnings over time to be a function of participation in CETA. An alternative possibility is to use an *autoregressive* model where pre-training earnings are used as a control: previous earnings should capture the (unobservable) innate ability fixed effect.

There remains a problem with the fixed effects model if creaming occurs. If, from among the pool of eligible applicants, administrators choose "only those individuals with the highest possible permanent income and the greatest negative transitory income" (Bassi 1983, p.542) i.e. if they choose those individuals who are only eligible for the programme because of (temporary) bad luck. This problem can be overcome by setting the base period benchmark to be a few years prior to programme participation. (There is a further statistical problem - simultaneity bias - if the training decision is endogenous to the individual, see Kiefer (1979) for a full discussion).

Evidence on the private returns to public training in the US is given in Table 3.1. This shows vividly how important it is to use a fixed effects model or autoregressive model rather than a simple cross section model to estimate the returns to training. Kiefer (1979) investigated the return to MDTA training using a sample of 600 male trainees and controls. In a simple cross section to explain earnings three quarters after training he finds training is *negatively* associated with earnings (earnings here includes both the wage and the probability of employment). In this cross section regression he controls for age, schooling, race, marital status and region but still finds that individuals who went through MDTA training have, other things equal, earnings 11 per cent below non-trainees. However, when the analysis is done properly, using a fixed effects model, training is *positively* associated with earnings. It is clear, therefore, that the simple cross section result is misleading and is the result of selection bias - less able individuals went through the MDTA programme and in the simple statistical analysis this showed up as training reducing earnings.

TABLE 3.1

Private return to CETA and MDTA training

Author	Sample	Method of overcoming selection bias	Control variables	Training effect
Bassi (1983)	CETA 1976 cohort — n = participants / controls white women 1,417 / 1,491 minority women 724 / 366 minority men 783 / 317	Fixed effect		$1978-79 white women 1,145 minority women 788 minority men 133
Sawhey et al. (1982)	CETA and controls n= 253 Boston 1976/77	Autoregressive i.e. pre-program wage	age, sex, race, education English speaking, pre-program public assistance recipient	wage $0.20 per hour employment + 49%
Kiefer (1979)	MDTA and controls, males n = 600 late 1960s	(i) Simple cross section i.e. contains selection bias (ii) Fixed effect	age, schooling, race, marital status, region age	quarterly earnings - 11% + 1.5%

The most thorough analysis of CETA training is by Bassi (1983). She analyses the 1976 CETA cohort and an equivalent comparison group. The change in the annual earnings of CETA participants as compared with non-participants is given in Table 3.1. Participation in CETA is positively associated with the change in earnings and training has a bigger effect on women's earnings than on male earnings.

The autoregressive method of controlling for selection bias is used by Sawhey et al. (1982). They study the impact of CETA Title I training programmes administered by the Boston prime sponsor. Their comparison group is individuals who had applied for, but not received, training. They identify separately the payoff to particular types of CETA training like autos, clerical etc. The impact of CETA training is divided into its effect on job retention and its effect on the wage. In both cases the most important determinants of the employment status and current post-training wage are the type of training and job characteristics, demographic characteristics are relatively unimportant. On employment status, those individuals who completed CETA training were 49 per cent more likely to have retained their jobs six months post training than non-trainees. And for those in employment CETA training is associated with trainee wages $0.20 per hour (1976-77 dollars) higher than the wage for equivalent non-trainees. But there is considerable variation round this average: four types of training - medical, food preparation, automotive and new careers - yield at least 30 cents per hour extra, while shop, clerical, home-maker and electronic training yield jobs paying not much more than those held by non-trainee comparison group.

Even proper longitudinal studies, with a control group, seldom have information on earnings for a long period after training. An exception is the fascinating study of Fredland and Little (1980) on the returns (in civilian life) to military vocational training. Their sample is 1,306 white men aged 45-49 in 1966, of whom 352 had received vocational training in the military often during World War II. A cross section regression on 1966 earnings was estimated. Control variables included schooling, job tenure, socio-economic status and region. Those who use their military vocational training in their civilian jobs get a premium in annual earnings of 12 per cent. Those who received, but did not use their military vocational education get no pay premium. A similar pattern holds for users and non-users of civilian vocational training. These results are important in context of whether vocational training actually raises productivity or whether it is merely a screening device. Assuming that there is no ability difference between users and non-users of vocational training the results imply that such training does raise productivity - it is only the users that get a premium.

Federal manpower training programmes normally use a delivery system in which the planning of types of courses and choices of schools have been the responsibility of either public administrators or various volunteer members of manpower planning boards. O'Neil (1977) suggests that greater reliance on the private market mechanism might be both more efficient and more equitable. Thus the extensive proprietary vocational - technical school industry could be used to supply training places and/or programme participants could be given more discretion in choosing both the type of training they wish to take and the institution they wish to attend by more use of voucher-delivery systems. O'Neil examines the payoff to the GI Bill, which uses a voucher-delivery system and contains sub-groups of recipients and training options that are similar to those of manpower programmes. He finds, using longitudinal data with appropriate controls, that the GI Bill-supported vocational training is associated with an earnings increase of around 10 per cent, rather higher than the estimate (for men) for Federal manpower training programmes. Further black veterans participate more than non-black veterans in GI Bill-supported vocational training, and they gain more from such training than non-blacks.

We have shown that the most thorough way of calculating the private return to public (or private) vocational training programmes is from longitudinal data on earnings for participants and a comparison group. In view of the fact that it is difficult (i.e. expensive) to collect longitudinal data on earnings the US Department of Labor compare the performance of prime sponsors and their contractors by constructing placement data. But Gay and Borus (1980) show that placement in a job within three months after leaving a program is among the poorest performance indicators. This variable was not significantly correlated (where the observations are prime sponsors) with subsequent gain in earnings for any of the 20 race/sex/programme groups they studied. They conclude that "placement data provide no useful information for judging the relative effectiveness of prime sponsors by the US Department of Labor or of contractors by local prime sponsors when considering earnings gain". (p.42). They point to several reasons why merely obtaining employment following training is unlikely to be related to the long-run impact of the programme. First, job placement does not convey any information on the nature or quality of post-programme employment. Changes in weeks worked, wage rates and earnings each embrace additional dimensions of post-programme work experience and thus have a better chance of reflecting subsequent long run benefits. Second, many job placements are not related to the skills acquired during training, so placement may not by itself constitute an improvement in a trainee's labour market circumstances. Third, additional job search may turn up a job with better long run prospects.

3.2 Vocational training in Britain

Three issues are addressed here. First, we describe the extent of vocational training in the British labour force and analyse who gets trained and the impact of such training on occupational status and mobility. It is generally held that the British training effort is deficient compared with other countries. Therefore, second, we analyse some economic aspects of public *provision* of adult training. This provides insights into, for example, cost-benefit analysis using a before/after method rather than a control group and the impact of the recession on the payoff to state-provided vocational training. Third, not only can the state provide training itself, it can also intervene to make the private market for training work better. Various market failures have been alleged, including externalities (poaching trained labour), imperfect capital markets, and non-competitive labour markets. These are examined in turn. The major omission in this discussion of vocational training in Britain concerns the recent expansion of public support - mainly in the form of allowances - to the Youth Training Scheme (YTS). Essentially YTS is for school leavers who would otherwise be unemployed. Although it is supposed to have a training component it was introduced in the face of rising youth unemployment rather than because of concern over the quantity and quality of teenager training. In any event the YTS only came on stream in 1983 so it is too early to evaluate it yet.

Extent and effects of vocational training in Britain

The National Training Survey was commissioned by the Manpower Services Commission in 1975 and 1976 to provide a comprehensive picture of the stock of skills in the labour force, the education and training undertaken to acquire them and the uses to which they were put. Some 54,000 people were interviewed, representing 1-in-500 of the working population. Training was very broadly defined, as "anything which may have helped you do the work". This definition covered all the types of vocational courses, both on-and-off the job, but excluded academic courses at colleges i.e. it excludes much vocational training which leads to a formal qualification like a teaching certificate (Claydon 1980). Over 60 per cent of respondents said they had undertaken some form of training during their working life (three quarters of men compared to half of the women) and almost half of this had been on-the-job. This implied that 11.5 million men and 7.5 million women in the working population had received some training.

Greenhalgh and Stewart (1982) have analysed the NTS data using a logit model to see who did and did not receive full-time training (as defined above) during the period 1965-74. Separate information is presented for men, single women and other women. Not surprisingly age has a stronger effect on the probability of training than any other variable. Each additional year of age reduces the probability of training by 6 per cent.

The occupational position at the start of the ten year period (1965-74) is positively related to the probability of training during the decade for men and single women but negatively related for married women. Likewise, for men, the higher the qualifications possessed at the beginning of the period the more likely a spell of training during the period. Finally, married men are more likely to have a spell of training than single men.

The impact of training on occupational status has also been examined. Greenhalgh and Stewart (1982, Table 10) find that, for men, a spell of full time vocational training pre-1965 of a year or longer raises the occupational status in 1975 by 7 per cent and a spell of any length betwen 1965 and 1975 has a similar effect. Metcalf and Nickell (1982) confirm that occupational movements between 1965 and 1975 are positively associated with vocational training: those men who had a short course of full-time vocational training (4 weeks or less) rose in the occupational standings by 1 per cent for each week of such training.

Vocational training is, other things equal, associated with a higher level occupation. There has also been concern in Britain that, as compared with Germany, the extent and type of vocational education is associated with the economic performance of the country (Prais 1981, Sorge and Warner 1980). Prais argues that the essential difference between Britain and Germany is in the proportions of the labour force with intermediate qualifications such as apprenticeships or full secretarial qualifications. The figure for Britain is around 30 per cent while the corresponding German figure is twice as large. The German system emphasises formal exams, both in classrooms and on-the-job, while the British system is more informal and has no proper test of the on-the-job training element. Prais concludes that "In a world of more rapid technical progress and faster economic change, the balance of advantage has shifted towards systems which provide a much greater stock of transferable skills, in which formal training and external examinations - of both theoretical and practical aspects - play predominating roles". Sixty five years ago Alfred Marshall (1919) wrote that "All the world has much to learn from German methods of education" and Prais demonstrates that, for Britain at least, that is still true. We now turn to examine state provision of adult training and the role the state might play in correcting market failure which results in the underprovision of skilled labour.

Public training programmes for adults in Britain

Some £3 billion is spent on all adult training throughout further education and industry. Most public spending on adult training and retraining is via the Training Opportunities Scheme (TOPS). This offers (i) training to unemployed individuals in skills which are intended to lead directly to employment, (ii) work preparation courses to reduce particular difficulties experienced by some people in finding jobs. Full details of TOPS training is given in Table 3.2. TOPS cost £230 million in 1982/83, of which £72 million was the cost of the skill-centres (net of trainee allowances). The MSC has a network of 68 skill-centres and 20 annexes which employ 4,500 staff and which supply off-the-job training under MSC programmes and to employers who contract for their services. Skill-centre courses last for around six months and the individual is trained to near craft standard.

TABLE 3.2

Training institutions used and skills taught under TOPS 1982/83

Institutions used	
Skill-centres	27,900
CFEs and private colleges	29,900
Employers establishments and HGV	5,800
Residential training centres	700
	59,300
Skills taught	
Clerical and commercial	10,800
Business	1,200
HGV	450
Construction	5,800
Technical and computer	7,000
Engineering and automotive	13,300
Work preparation	12,500
Other	8,200
	59,300

Source: MSC (1983 Tables 4.1 and 4.2).

Note: Figures refer to number of training places. Courses typically last under one year, therefore the number of people trained in 1982/83 was greater than the number of places.

The payoff to skill-centre training (skill-centres were previously named Government Training Centres) has been analysed in a whole series of publications by Ziderman (1969, 1973, 1975, 1975a, 1976, 1978). Some typical results are reported in Table 3.3. In all this reserach Ziderman had no control group therefore he uses the before/after method (see Section 6). He only has earning information for the period up to around 2 years post-training, so he assumes the pay differential at the 2 year post-training point will persist into the future. As he has no control group he has no information on what the employment and earnings experience of the trainees would have been if they had no been through the GTC. Therefore he uses a stochastic Markov chain model to predict by computer simulation the hypothetical employment pattern of enrollees in the absence of training. The employment status of "non-participants" (i.e. of the enrollees, had they not, infact, participated in the programme) is estimated in terms of proportions unemployed and employed, at various points of time from the start of the programme. These, together with earnings data relating to trainees in the 'before' period (suitably corrected for the secular rise in incomes over the period) provide estimates of mean earnings that programme enrollees would have received had they not participated in the programme. The private rate of return to GTC training is higher for those who were employed prior to training than those who were unemployed because of the post-training. The social rate of return is below the private rate and its value depends on the assumptions made about replacement and displacement.

TABLE 3.3

Rate of return to investment in GTC training in 1968-69 (%)

Time horizon from start of training	Private		Social		
	Unemployed prior to training	Employed prior to training	$\alpha,\beta = 0$ $\gamma = 0$	$\alpha,\beta = 0.25$ $\gamma = 0$	$\alpha,\beta = 0.75$ $\gamma = 0.25$
2 years	< 0	33	< 0	< 0	< 0
10 years	58	86	4	25	47

Notes: α = replacement factor

β = displacement factor in non-training trade

γ = displacement factor in training trade

Source: Ziderman (1975 Table 13.2), Ziderman and Driver (1973 Tables 2 and 3).

In all cases except zero replacement and displacement the rate of return adopting a ten year time horizon shows that in the 1960s the investment was very profitable and this is one reason why public adult training places were expanded in the 1970s.

Some attention has been given to where state adult training centres should be located. Hughes (1975) suggests that the regional location pattern should be based on: (i) total applications for GTC courses per region in relation to training places available, should the policy objective of GTCs be social rather than economic; (ii) incidence of structural unemployment, in relation to training places, if economic objectives prevail; and (iii) as a supplementary criterion, the capacity utilisation rate, as a measure of the efficiency with which the capacity is used. On the basis of these criteria Hughes argues that the northern part of Britain is over-endowed with GTC places relative to the southern part (historically the northern part of Britain has an unemployment rate double that in the southern part). But Ziderman argues that location decisions should be based on cost-benefit analysis and shows that the social payoff to GTCs (now skill centres) is higher in the north than the south. This debate is unresolved but is clearly important, particularly if the supply of training places is to be contracted or expanded.

There is evidence that the high rates of return to public training of adults (Table 3.3) are now a thing of the past. The employment experience of TOPS graduates at the end of 1982, three months after finishing their courses was:

	Skill centres	Non-skill centres
In employment (%)	44	57
In employment, using skills (%)	34	46

Thus only around half the graduates from training programmes were in employment three months after finishing their training and only two fifths were using their skills. The difference between the skill centre figures and those for non-skill-centres partly reflects the poor employment prospects in the mechanical engineering craft occupations which form a significant proportion of skill-centre training. In the face of this evidence the TOPS programme is to be halved. Skill-centres will, in future, operate on a cost-recovery basis (i.e. the individual or the firm will be charged for the training) which will cut down on speculative training. Rather public spending on adult training will in future concentrate on upgrading technical skills (50,000 p.a.) and will help training in information technology (50,000 p.a.). This expansion in the training programme is mainly addressed to already-employed workers and some schemes will be financed by loans (rather than trainee allowances and zero fees). Unemployed people will be catered for mainly by splicing a training component into the Community Programme for the long term jobless.

There will also be a big expansion in training for self employment: Around a tenth of th British labour force is self employed. The New Enterprise Programme (NEP) is designed to train people for self employment. It is directly financed by the Manpower Services Commission (MSC) which specifies the objective of NEP as getting people into business "quicker, with fewer mistakes and surviving longer". Participants on the NEP must normally be unemployed at the time they go on the course. Each programme lasts 16 weeks. The first month is a residential period at a Business School and the remaining twelve weeks are spent putting a business proposal into practice. A small NEP has been evaluated by Johnson and Thomas (1982). The cost side was straightforward. But the benefits side is problematic. They had no control group so they simply asked trainees what their employment would have been in the asbence of training. The interview took place two years after the NEP and they assume that the benefits last for five years. Thus participants had to forecast actual employment for years 3, 4, 5 and alternative employment for all five years. The authors made various assumptions about the extent to which the output of the new firms displace output of existing firms. The calculated social internal rate of return (using only a 5 year benefit period) is 20 per cent. This suggests that the proposed expansion of training for the self employed is sensible.

Public intervention to support training provided by firms

It is generally believed that Britain has insufficient skilled labour. Three market failure arguments - externalities, imperfect capital markets and labour market monopolies - have been advanced as possible causes.

First, the 1964 Industrial Training Act established a system of Industrial Training Boards (ITBs) with the right to impose levies on and to pay grants to firms. The object of the Act was to increase the supply of skilled labour by "re-distribution of the burden of providing industrial training from firms which were relatively generous providers to those which undertook relatively little" (Jones and Hollenstein 1983). Supporters of the grant-levy approach argued that some firms incurred net costs to provide training in skills which were transferable among firms. In turn, firms not providing training poached away the trained labour. This, it was argued, was unfair and inefficient because ultimately the supply of firms providing training would dry up. But there was no analysis of how this situation arose in the first place and how poaching-firms and training-firms existed side-by-side.

Second, opponents of the grant-levy approach argued that the costs and benefits of general training for transferable skills accrued to the individual and poaching was therefore irrelevant. Rather, if there were not enough trainees, this was because the capital markets were working badly and individuals could not borrow to augment their skills. In this case the solution to any deficiency in the supply of trained labour was not to introduce a grant-levy system but to intervene to improve the supply of funds for investment in human capital.

Third, there may be an insufficient supply of generally trained labour with transferable skills if trainee pay is high relative to the earnings of skilled labour. Jones and Hollenstein show that the higher is trainee pay relative to that of skilled workers, the lower will be the employers' demand for all types of trainee labour and the less skill-intensive and more firm-specific on average will be the training opportunities offered. In Britain the earnings of apprentices and other initial trainees are double or treble those of apprentices in Germany and Switzerland over the period of their apprenticeship and it is unlikely that their productivity is correspondingly higher. Three solutions suggest themselves to this problem: (i) parties to the pay bargain might try to mirror the competitive outcome more nearly; (ii) trainee wages could be subsidised; (iii) more general training could be provided in public sector institutions.

3.3 Summary

The supply of skilled labour in industrialised countries may be deficient because of externalities (poaching), imperfect capital markets which make it difficult for a person to finance his training or labour market monopolies which cause the trainees wage to be high relative to his productivity. The state therefore sometimes intervenes to increase the supply of skilled labour. Forms of intervention include a levy-grant system, subsidising trainee wages and public provision of training slots.

The studies surveyed here evaluate public training programmes by using earnings data. The results suggest that the best evaluations have both longitudinal earnings data for the period before and after training and observations on trainees and a control group of non-trainees. These lessons are digested and elaborated further in Section 6 and 7.

SECTION 4

Substitution

4.1 Introduction

Before thinking about the method of evaluating vocational training two prior issues need to be considered. First, is the production technique in the firm or industry economically efficient? If it is not, and a more labour-intensive technique would be appropriate, then employment of both skilled and and unskilled labour might need to rise. Second, given the output and the capital is it possible to substitute less skilled for more skilled labour? Therefore we must pay a passing glance to the elasticity of substitution between capital and labour and between different labour types.

There are many reasons for estimating such substitution elasticities. These reasons include: to test the helpfulness of manpower plans; to determine whether or not extra education is a powerful vehicle to alter the income distribution; growth accounting; to test the impact of subsidies on either capital or labour; and to see the substitution possibilities within a training programme. It is this last point that is examined here. Empirical estimation of the elasticity of substitution is necessary to study the effect of a training programme which converts low to high skilled labour. The effects depend on how substitutable these are in production, for the substitutability will determine the extent of the change in their relative wages in the new post-training equilibrium. A positive value for the elasticity implies that the factors are substitutes and a negative value implies that they are complements.

4.2 Appropriate technology and the demand for skilled labour

The issues of the appropriate production technology is controversial, especially in developing countries. For our purposes the important strand of this analysis is the skill requirements implied by a more labour-intensive technology. Even lower skill intensities in the appropriate least cost technology may require a larger absolute number of skilled workers given the greater total employment.

Some evidence on this is given in Table 4.1 taken from Pack's (1982) illuminating survey. In shoes and leather processing the appropriate (i.e. more labour-intensive) technology requires a higher proportion of skilled workers than the capital intensive technology, while in brickmaking and maize milling the skill intensity of the labour force is higher with the capital intensive technology than with the appropriate technology. But even lower skill intensities in the appropriate technology in brick production and in maize milling require a larger absolute number of skilled workers. As Pack points out, critics who are sceptical of the feasibility of labour-intensive technology might well feel vindicated by such a result: even in brickmaking, in which the skill intensity per project is lower with the least cost technique, the aggregate skill requirement is greater. That requirement reflects both the larger total employment per project and the larger total number of projects that can be undertaken given their lower capital-output ratio.

But the analysis cannot end here. Pack points out that what is required is a calculation of the cost of obtaining the additional skills and a comparison with the benefits to be obtained from the choice of least-cost technology thus made possible. Table 4.2 presents such computations for leather processing and for shoe manufacturing, the two sectors showing the largest absolute increase in skill requirements. The figures are the benefit-cost ratios that prospective investors could anticipate from expenditure on

TABLE 4.1

Skill differences between processes, by sector

Sector	Percentage of skilled workers		Absolute difference in number of skilled workers required per £100 million of investment (appropriate minus capital intensive)
	Economically efficient	Capital-intensive	
Shoes[(a)]	58	55	5,744
Leather processing[(a)]	42	26	1,464
Brickmaking[(b)]	2	7	445
Maize milling[(b)]	9	13	746

Source: Pack (1982), Table 8.

Notes: (a) With appropriate technology both the proportion and the absolute number of skilled workers rises.

(b) With appropriate technology the proportion of skilled workers falls but the absolute number rises.

skills necessary to implement appropriate technology. These are indeed "remarkably high" and "they suggest that those who believe skill constraints to be the principal factor limiting the adoption of labour-intensive technologies might consider advocating a bundling of the requisite education and investment funds rather than urging a resort to capital-intensive technologies" (p.24). While training associated with Bank projects typically takes the technology as given the need for such labour-skill upgrading would be even greater, it seems, with appropriate technology.

4.3 Substitution among different types of labour

If the technology and output level are taken as given we should ask whether different types of labour are substitutable for each other in the production process. If it is easy to substitute unskilled labour for skilled labour (i.e. if the elasticity of substitution is high) obviously training is needed less than if such a substitution is difficult (i.e. if the elasticity of substitution is low).

Before turning to the results of various studies I wish to mention, very briefly, some serious estimation choices and problems, which interact to cause us to treat the estimates of the substitution elasticity with some scepticism.

First, is the elasticity of substitution between different labour types to be estimated via a production function (e.g. Layard et al. 1971), a cost function (e.g. Nissim 1982) or simply by contrasting relative wages with relative employment levels? Most studies use the last approach.

Second, the observations can be drawn from time series or a cross section. If cross section data are used they can refer to countries, regions, industries or firms.

TABLE 4.2

Benefit-cost ratios from investment in upgrading skills

Sector	Assumed borrowing rate of skilled workers	
	10%	20%
Shoe manufacturing	35	68
Leather processing	54	105

Source: Pack (1982), Table 9.

Notes: The benefit-cost ratio is calculated as follows

$B/C = \Delta Y/(S_b - S_a)G$, where:

ΔY is the present discounted value ($i = .10$) of the additional non-wage income obtained from the appropriate technique

G is the amount of investment in upgrading skills that would now have to be spent by a firm on each currently unskilled worker to obtain the requisite skills to produce with an appropriate technology

S_b and S_a are the number of skilled workers required by the appropriate and capital-intensive technology per £100 million of investment

Third, how should the labour input be defined? For our purposes we are interested in studies of substitution between skilled and unskilled labour or between labour with different education levels rather than between age categories or sex. But how aggregate or disaggregate is the level of skill to be defined. Most studies aggregate labour into only two or three categories. This is bound to miss something. For example, it may well be that substitution possibilities are greater between (say) semi-skilled and unskilled workers than they are in the higher categories of management. Layard et al. (1971) attempted a fivefold classification of labour in their study of the relationship between economic performance and qualified manpower in 68 factories in the electrical engineering industry. They were unable to say anything definite about substituting more trained for less trained workers and indeed, were forced in the end to estimate the production function with only two labour types. (We may note in passing that such aggregation is one reason why manpower forecasting is ostensibly so attractive - it has a range of occupational titles that cannot be matched in substitution studies or rate of return analysis).

Fourth, most studies use the "short cut" estimation method of associating relative wages by skill group with relative employment by skill group and simply assume that the observations lie on a labour demand curve. Tinbergen (1974) points out that strictly studies should control for the elasticity of supply of labour too but very few do so. For an example of a study that did make such a control see Fallon and Layard (1975).

Thus, fifth, there is a question of the simultaneous determination of relative pay and relative employment. However, when such an association is estimated at industry level it seems correct to take relative wages as the exogenous variables (e.g. Knight 1979). This in turn raises a further related problem: when the observations refer to one country - industries or firms perhaps - there may be insufficient variation in relative wages to obtain good estimates of the substitution elasticity.

Sixth, what other variables should be included in the statistical analysis? In cross country studies it seems important to control for industrial structure (Bowles 1970). If capital is ignored, as it is in many studies, we get biased estimates of labour - labour substitution unless labour is separable from capital, i.e. unless the elasticity of substitution between capital and the various types of labour skills are identical. When capital and industrial structure are included in the analysis and we also control for the supply elasticity the resulting estimates of the substitution elasticity fall sharply compared with estimates made without such controls.

The results of some studies which have attempted to analyse labour - labour sustitution are given in Tables 4.3 and 4.4. Table 4.3 presents estimates from cross section studies and Table 4.4 from two studies which use time series data. The results are selective because the authors typically present more estimates than I have reported. The results seem clear on two counts. First, unskilled labour and skilled labour are generally substitutes (i.e. the sign of the elasticity of substitution is positive). Second, the size of the substitution elasticity is perhaps somewhat smaller than was thought on the basis of previous estimates done more than a decade ago. These results are in line with those surveyed by Hamermesh and Grant (1979) for the U.S. who conclude "Almost all the studies

TABLE 4.3

Selected cross section estimates of the elasticity of labour-labour substitution

Author	Sample year	Observations	Type of function	Independent variables	Elasticity of substitution	Labour type
Bowles (1970)	1960s	12 rich and poor countries	Inverted labour demand	Relative employment industrial structure	5.9	0-7 years ed/ 8+ years ed
Psacharopoulos and Hinchcliffe (1972)	1960s	9 rich countries	Inverted labour demand	Relative employment K : L	20	8-11 years ed/ 12+ years ed
		9 poor countries	Inverted labour demand	as above	2.5	8-11 years ed/ 12+ years ed
Fallon and Layard (1975)	1963	23 countries	Simultaneous labour supply, labour demand model	Capital stock (D) Relative employment (D) Rate of return (S) Output per head (S)	1.1	Human capital/ raw labour
	1963	Mining 16 countries	Labour demand	Relative wages	.78	Human capital/ raw labour
	1963	Construction 14 countries	Labour demand	Relative wages	.20	Human capital/ raw labour
	1963	Utilities 16 countries	Labour demand	Relative wages	.44	Human capital/ raw labour
Ahmed (1981)	1979	Construction firms:				
		20 Rawlpindi	Labour demand	Relative wages	-0.65	Skilled/unskilled
		15 5 other cities	Labour demand	Relative wages	0.66	Skilled/unskilled
		35 all 6 cities	Labour demand	Relative wages	0.21	Skilled/unskilled

Note: Estimates from Layard and Fallon are averages from the range of estimates they give.

TABLE 4.4

Selected time series estimates of the elasticity of labour-labour substitution

Author	Sample years	Observations	Type of function	Independent variables	Elasticity of substitution	Labour type
Nissim (1982)	1963-78	G.B. mechanical engineering (n=22)	Dynamic translog cost function	Wages Capital stock Output time trend	1.7	Skilled/unskilled
					2.6	Skilled/semi-skilled
					3.7	Semi-skilled/unskilled
Knight (1979)	South Africa		All examples are 2 tier production function	Relative employment time trend in all cases		Black/white in all cases
	1955-76	Aggregate Mfc			.39	
	1955-76	Gold mining			.14	
	1955-76	Other mining			-.25	
	1962-76	Basic metals			.02	
	1962-76	Wood			.17	
	1962-76	Chemicals			.03	
	1962-76	Electrical machinery			-.09	
	1962-76	Food			.14	
	1962-76	Furniture			.42	
	1962-76	Leather			.58	
	1962-76	Machinery			.20	
	1962-76	Metal products			.01	
	1962-76	Transport			.68	
	1962-76	Textiles			.14	
	1964-76	Paper			-.93	
	1964-76	Beverages			.22	
	1965-76	Tobacco			-.06	

find that production workers and capital are substitutes, as are production and non-production workers" (p.529). Likewise, Tinbergen and Psacharopoulos (1983 Table D4) surveyed nine studies and in each case found that highly trained labour and other labour are substitutes in the process of production.

The thrust of these results from statistical analyses is confirmed in an illuminating case study approach which examined the labour and capital inputs in a number of thermal power stations over a range of different countries (Shiba 1983). It was found that given the technology "a high level of education can be substituted for lack of experience" and across plants the average experience level of the labour force is negatively associated with the level of education. Further, more sophisticated technology requires a higher level of education and experience, confirming the complementarity between physical and human capital.

4.4 Conclusion

The results discussed here have two important implications for vocational training. First, economically efficient production technologies sometimes imply more labour intensive technology which, in turn will tend to raise the demand for skilled labour and in turn, vocational training requirements increase. Second, in general, holding output constant, less skilled labour is, apparently, a substitute for skilled labour in the production process rather than a complement to it. Indeed, it may well be that the studies surveyed here understate the true degree of substitutability among different labour types (see e.g. Bennell). Thus labour is usually measured according to the occupation-description ("electrical engineer") rather than what the person actually does ("maintenance technician"). Training design certainly needs to operate on the basis of tasks rather than labels. Although the studies surveyed in this section do not relate specifically to the level of the firm (typically the data refer to industries or whole economics) the possibility that less skilled labour is substitutable for more skilled labour, and vice versa, needs careful investigation prior to any evaluation of vocational training.

APPENDIX

The elasticity of substitution (σ_{ij}) between different types of labour L_i and L_j represents the inverse of the percentage change in the ratio of wages assoicated with a given percentage change in the ratio of labour quantities. Explicitly:

$$\sigma_{ij} \equiv - \frac{\partial(L_i/L_j)/(L_i/L_j)}{\partial(w_i/w_j)/(w_i/w_j)}$$

$$\equiv - \frac{\partial \log (L_i/L_j)}{\partial \log (w_i/w_j)}$$

A positive value for the elasticity implies that the factors are substitutes and a negative value implies that they are complements.

SECTION 5

Firm level studies

5.1 Introduction

"Recent work on the economics of training has tended to dismiss the possibility of using data obtained from individual firms" stated Thomas et al. (1969). Some fifteen years on that statement is generally still true. This is a pity because the few studies conducted at firm or plant level are outstanding. In what follows we initially examine one recent study which focusses on training costs, paying special attention to the thorny problem of estimating the costs associated with training carried out jointly with the production process. Then three issues on the benefits side are examined. First, if earnings are not used, how can extra output associated with the training be measured? It turns out that a rich variety of measures have been used including downtime, firm output, job performance and reduced turnover. Further, training may reduce input costs rather than increase output. Second, what do firm-level studies tell us about experience - earnings and experience - productivity profiles? In particular is the assumption of human capital theory that the experience-earnings profile can be explained by the experience-productivity profile confirmed? This is of profound importance to those who wish to estimate firm-level or social rates of return to training. In fact, the evidence counsels caution on the use of human capital theory. Finally, we briefly note two studies, one for the US and one for India, which have related a (non-earnings) output measure to the type of training received.

5.2 Training costs

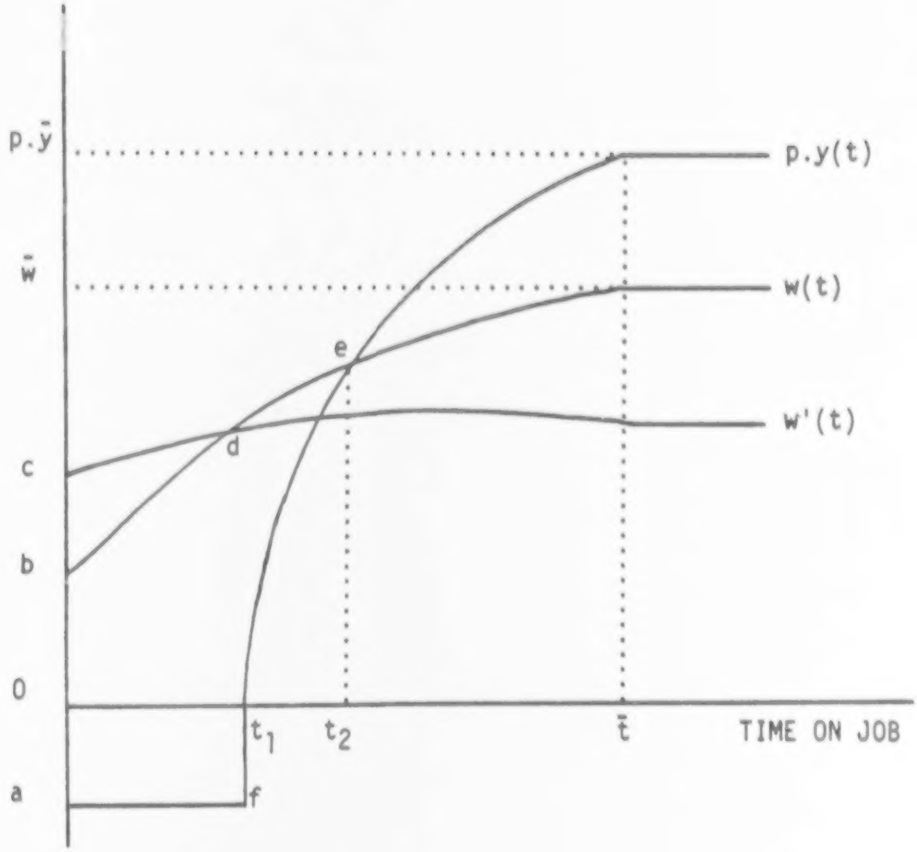
An early study of training at the firm level (Thomas, Moxham and Jones 1969) identified seven dimensions of the cost of training: initiating the training function; servicing and co-ordinating the training function; fixed training capital; working training capital; providing instruction; giving instruction; and wages of trainees, net of trained output value. These costs were fully discussed in Zymelman (1976). More recently Ryan (1980) suggested three cost categories in his lucid and complete examination of an arc welding training programme at a major US shipyard.

The flavour of Ryan's analysis is given in Figure 5.1. He defines job training as comprising "all forms of learning which raise an individual from requisite general educational attainment towards the level of competence characteristic of experienced workers in the job in question" (p.334). The curve p.y (t) in Figure 5.1 depicts the learning curve of trainee net output (valued at a price p) for a training programme consisting of an initial spell of formal training in a company school (Ot, periods) followed by a phase of informal training consisting of instruction and/or learning by doing on actual production work. The training period is defined not by the period of explicit instruction in job techniques but by the time (O$\bar{t}$) it takes a typical individual to obtain the plateau of output, $\bar{y}$.

Ryan indicates that both the employer and trainee may bear the costs of job training. The individual bears costs in the form of foregone earnings. If his actual path of earnings is defined by w(t) and his alternative earnings by w'(t) then foregone earnings are represented by area bcd. The cost to the firm is trainee pay less (net) trainee output. In Figure 5.1 this is given by the area abef.

FIGURE 5.1

The cost of in-service training



Notes: p.y(t) value of net output in period t

w(t) compensation of worker in period t

w'(t) best alternative income of trainee in period t

Source: Ryan (1980), Figure 1.

Firm level case studies indicate that it is possible to get at the costs of formal training, possible - but tricky - to get at foregone earnings, but very difficult to calculate the net costs of informal training.

Ryan states that "the most accessible costs are the resources committed by employers to courses of formal training conducted in company schools, which can be estimated in a relatively straightforward manner from accounting records and purchase prices". Earnings foregone can be got from direct estimates (this is what is done in the recent evaluations of government training, where earnings in (last) employment prior to training are used), personal interviews and data on the relevant labour market.

Estimating the cost to the firm of on the job training is difficult. Problems include: (i) the price the output of the trainee is sold for; (ii) how to measure trainee output; (iii) how to measure trainee usage of other resources such as equipment and instruction, and of the value to the firm of alternative uses of such incremental resources: thus we require information on the variation with (in)experience of productivity supervisory requirements, machine wear and tear etc. Valuation of trainee output (i.e. problems (i) and (ii) above combined) is the most difficult task. Ryan points out that as most workers perform only a subset of the many operations involved in the completion of a marketable product, a shadow price is required for their intermediate products. There are two possible ways of estimating shadow prices:

(a) via the payments system: Thomas et al. (1969) use the ingenious assumption that pay and value product of trainees are equal at the 'breakeven' level of output level which makes a worker eligible for bonus payments.

However, this assumption is arbitrary. As Ryan points out, it requires that the design of the payment system be informed by the very same training costs which are to be estimated on the basis of assumption.

(b) via the finances of the training programme i.e. from the influence of such a shadow price on both the costs and returns of informal training. If an exogenously imposed rate of return could be assumed the shadow price of output would be uniquely determined for a given rate of labour turnover. In general, there is no unique value to trainee output. Ryan therefore proceeds on the basis that the cost to the firm of informal training is estimated by assuming equality between the pay and value product of experienced workers.

Ryan's analysis refers the cost of the core skill required of all shipyard welders, the manual welding of heavy guage steel plate with the use of coated electrode. The training process consists of an initial spell of between six and eight weeks of formal instruction and practice in a vestibule school, followed by a year or more of production work until proficiency is acquired. Welders are hired at all stages of the learning curve. The cost to the firm of training a beginner up to Mechanic status is given in Table 5.1 ($1,975). The total cost to the firm was almost $6,000. By contrast Ryan calculates that the trainees incurred no financial costs - their pay was greater than their best alternative income. The returns to the firm from this investment are examined in the section on pay, productivity and experience.

TABLE 5.1

Firm cost of training a welder, U.S. shipyard, $1975

Cost		$
Formal training		
Hiring		122
Training		1772
Pay of trainees	1341	
Pay of instructors	253	
Materials etc.	178	
Sub total		1894
Informal training		
Pay above output value		3858
Extra maintenance		333
Supervision		482
Extra electrode material		376
Sub total		5070
Reduce this sub-total to allow for fact that value product of experienced welder must in general exceed his pay, say by 20%. Therefore multiply 5070 by 1.0/1.2		
Revised sub total		4008
TOTAL:		5902

Source: Ryan (1980), Tables 2 and 3.

5.3 Productivity, output and input

Any evaluation of training must have a measure of the benefits of that training. Typically such benefits are measured from earnings data. But earnings may not, in fact, reflect productivity. For example, pay may be related to seniority. Or pay scales may be mandated. Or multinational companies in developing countries may have their own peculiar pay scales. And even in the human capital version of earnings determination at any point in time pay need not equal productivity. Therefore in this section four alternative ways of measuring productivity are examined. First, job performance assessed by supervisors is discussed. Second, the production function approach - possible where data exist on inputs and outputs over a cross section of plants - is presented. Next we describe one of the most ingenious studies which details downtime in productive equipment. Finally the relationship between labour turnover and productivity is noted.

Job performance

Human capital theory assumes either explicitly or implicitly, that the reason pay rises with experience is because productivity rises with experience. This has recently been tested by Medoff (1980) and Medoff and Abraham (1981). Here we are only concerned with their measure of productivity. Their results, which have profound implications for evaluating training, are discussed below. I concentrate here on their discussion of company C (Medoff and Abraham 1981), but the discussion of companies A and B (Medoff 1980) is similar.

The sample is 8,238 white male managerial and professional employees at a major US Corporation in the mid 1970's. This company uses two separate measures of job performance: an overall performance *rating* with nine categories and a *ranking* of each employee relative to others in an appropriate comparison group. These measures are prepared by each employees immediate supervisor. The performance rating form gave supervisors the following instructions: "Each employee should be rated on current performance and contributions based on requirements of his present assignment. An employee should be measured both as to his contribution in terms of the standard of his job and against others performing similar work at similar levels. Career potential and promotability should not enter into ratings of an individual's performance". For the rankings management provides each supervisor in a department or other appropriate organisational unit with a list of employees doing reasonably comparable levels of work.

The crucial question is whether these performance ratings and rankings are good indicators of relative-within-grade level productivity. Medoff and Abraham believe that they do measure productivity satisfactorily, but they raise four potential problems. First, in view of their findings (see below) that performance declines with seniority, are senior workers systematically underrated? For example supervisors might have higher expectations of more senior employees in a grade level and systematically give them more difficult assignments. In this case rated performance would be an understatement of senior employees relative within grade level productivity. They found no evidence that supervisors do expect more of more senior employees within a grade.

Second, an objective measure of productivity would be preferable to rated performance. But is is particularly difficult to get such an objective measure. The various dimensions of an employee's current true value to his or her firm would have to be quantifiable. Further, either there would have to be only one dimension relevant for assessing the employees true current worth or the researcher would have to know the proper set of weights to attach to each relevant dimension.

Third, there is cause for concern if performance ratings did not reflect solely the employees productivity in his current job, but also reflected his supervisors assessment of his potential for advancement. Other things equal more experienced (older) employees are typically less likely to be promoted out of any given grade than less experienced (younger) employees: older employees are perceived as having limited potential for future advancement. Therefore if performance ratings are affected by supervisors assessments of individuals future potential, more experienced workers might typically receive lower performance ratings than warranted on the basis of their current productivity. In fact, Medoff and Abraham find that this is not a problem.

Fourth, a test of whether performance ratings adequately measure productivity concerns promotion probabilities. Assume a company is more likely to promote or give large pay rises to those employees in a grade level whose current productivity is highest. Therefore if rated performance has a singificant positive relationship with the probability of promotion or the size of a pay rise this is good evidence that performance measures are positively correlated with true within-grade level current productivity.

There is also a further problem. Performance ratings may satisfactorily measure relative productivity among individuals but the ratings may not accurately reflect the absolute differences, and it is these absolute differences which matter when evaluating training. Performance ratings may be satisfactory for ordinal rankings but inadequate as a cardinal scale.

Fuller (1976) also used worker efficiency ratings as a measure of job performance. His single firm case study was designed to get at the cost-effectiveness of different types of training in three metal trades - turners, millers and grinders - in a large firm in southern India. Fuller describes the efficiency rating measure as follows: "For each metal cutting job standard hours had been estimated for the completion of various tasks. These were based on extensive time and motion studies. A worker's efficiency rating was completed by dividing standard hour estimates by actual hours required to complete the task. It is important to note that the results of all work had to conform to quality standards; if not a produced piece would be rejected and produced again. In this instance a worker would be charged with all the hours that he spent on the rejected piece and the new piece. Hence efficiency ratings reflect quality as well as quantity of work". To test the reliability of the measure ratings were taken for three years and correlated. The lowest correlation was .73. Fuller believes that such efficiency ratings are a better measure of job performance than, for example, pay: they are related specifically to a worker's individual output (quality and quantity), and already take into account extraneous factors affecting worker performance such as machine capacity, flow of materials from co-workers, ease of access to tools and instruments, and hardness of raw materials. It is interesting to note that (though this was not the focus of his study) Fuller's results are similar to those of

Medoff (1980) and Medoff and Abraham (1981). Pay was positively related to seniority but job performance was stable or declined with extra trade experience after the first few years on the job.

Production functions

Where data are available on inputs and outputs for a number of plants in the same industry it is possible to estimate a production function relating these inputs and outputs. An example, particularly relevant to firm level vocational training is Layard, Sargan, Ager and Jones (1971). Such a production function has two particularly useful properties for our purpose. First, it indicates the degree of substitutability among different types of labour - it indicates the number of untrained workers who can be replaced by one trained worker without loss of output. This whole issue was dealt with separately above. Second, it indicates the factors which influence output. The use of an aggregate production function where the outputs of many different products are added together, weighted by their market prices enables us to calculate productivity (strictly marginal product) directly in value terms. Such marginal product estimates are useful, in turn, in calculating the social return to training.

There are a number of statistical problems associated by estimating aggregate production functions using plant data. First, aggregation is only admissable, strictly, if the separate production functions of the different products have constant returns to scale and are identical, except for a scale factor applied to output. Thus is is assumed for example that the technology behind production of transformers is similar to that for producing electrical plugs. Second, great care is needed with measures of labour and capital. Third, there are a number of statistical problems.

These include: (i) multicollinearity; (ii) biased estimation procedures because (a) of heterogeneity in products, (b) the flow of services may not correspond to the stock of inputs, (c) simultaneous equation bias; (iii) if there is a large random error on output, which there typically is, it may be difficult to pick up the effect on output of inputs which contribute relatively little towards total output. These statistical problems were partly responsible for the fact that Layard et al. found that, when labour was disaggregated into five categories by quality it was impossible to produce reasonable estimates of the separate contribution to production of different types of labour.

Downtime

The productivity of personnel in the US Navy was studied by Horowitz and Sherman (1980) by examining the effects of personal characterisitcs, including experience and training, on the operational availability of ships in the US Navy. The analysis was confined to 91 cruisers, destroyers and frigates. The output of these ships could not be measured directly. But the ability of the crew to keep vital equipment in working order is a crucial intermediate product in the production of ship output. So the authors focussed on the material condition of shipboard equipment. Whenever a ship suffers an equipment failure that degrades its operational capacity it files a casualty report. One measure of the material condition of the ship is the number of caualties it has multiplied by the average time it takes to fix them: this measure is termed downtime. Such downtime will depend on the kind of equipment, the age of the ship, the length of time since the ship was last overhauled and the quantity and quality of men on board. Regression analysis was used to estimate the relationship between downtime due to shipboard failure and those factors.

Horowitz and Sherman did not study downtime for entire ships but concentrated on several sub-systems, chosen because they are common to a large number of ships and are maintained by men in a small number of occupations. The sub-systems are: boilers, engines, gun systems, missile systems, anti-submarine warfare systems and sonars. A further discussion of the factors which influence downtime is given below.

Reduced turnover

One of the earliest studies of industrial training which used the firm as the unit of observation is the fully fledged cost-benefit analysis of Thomas et al. (1969). The study was carried out in a factory employing 200 people making heavy duty clothes. Its original training scheme for machine operators, while carried out in a training centre, had been fairly relaxed. The cost-benefit study concerned the extra costs and benefits of the new scheme, which entailed a thorough course of training for instructors, a detailed analysis of jobs and the provision of a comprehensive training manual. The innovation was practised for two years then dropped in favour of the old system. But when management realised that the benefit-cost ratio of the new system was over 6-1 they re-introduced the more rigorous new training scheme. Some benefits derived from higher output relative to pay, but three quarters of the benefits associated with the new scheme were attributable to a reduction in labour turnover giving a longer average retention period.

Reduced inputs

Training may raise labour productivity or total factor productivity by reducing the inputs required to produce a given output, rather than by raising output for given inputs. In his study of a power station owned by the Tokyo Electric Power Company, Shiba (1983) indicates that extra training may reduce fuel inputs, repair costs and manpower requirements. He finds that manpower economies were the major savings because operators have more diverse skills and because more skilled labour means fewer accidents and failures. The manpower economies associated with the training imply a benefit-cost ratio to the training of 8-1.

5.4 Pay, productivity and experience

A particular merit of studies at the level of the firm or plant is that they permit us to examine the behaviour of experience-pay profiles and experience-productivity profiles. This is important for (at least) two reasons. First, human capital theory, which has come to dominate the explanation of earnings in recent years, requires, approximately (on average), equality in the net present value of earnings and productivity over an individual's tenure in the firm. The evidence cited below provides a test of this theory. It will be shown that, on occasion, there is divergence between pay and productivity at a point in time, sometimes pay exceeds productivity and vice versa and, more important, there is no consistent evidence of equality in net present values. Second, and flowing from this first point, rates of return to the firm and to society on resources comitted to training may not always be correct if pay is used to measure value product. While rates of return to the individual are unaffected, we may need to be more cautious in drawing conclusions on the basis of the social or firm-level rate of return. The relationship between experience-productivity profiles and experience-pay profiles is examined by Medoff (1980) and Medoff and Abraham (1981). Their studies are important because they indicate that pay is, for their sample at least, not always a good indicator of the value of output produced by the individual.

The Medoff and Abraham sample refers to 8,238 white, male, managerial and professional employees at a major US corporation in the mid 1970's. Each year 1973-77 the employee record included information on the employees education, length of company service, date of birth, physical work location, current job grade, date of entry into current job grade, current pay and recent pay history and two measures of employee performance plus an assessment of the employees potential for advancement. The information in the other two company case studies (Medoff 1980) is similar and is not discussed here.

The authors present both cross section evidence and longitudinal evidence. They proceed in three stages in the cross section work. First, they confirm that pay rises with experience and, as expected, the payoff to current-company experience is larger than to pre-company experience. Second, they determine that substantial fraction of the positive pay-experience relationship occurs within a grade, rather than solely because more experienced employees are more likely to get promoted. This is a necessary step because the productivity measure is performance rating and it must therefore refer to tasks of the same difficulty. Finally they ask whether the experience-earnings differential can be explained by an experience-performance differential. If more experienced employees in a grade received higher pay because they are more productive, the introduction of variables capturing relative within-grade performance into the regression should move the within-grade-level returns to experience towards zero - the performance measure(s) would "steal away" the experience effect. In fact, when the performance measures are included the returns to experience rise, they do not fall. Thus within grade pay rises with experience, but productivity does not (see above). The concept of human capital requires that productivity can be measured by pay. In general this condition is probably met, but the Medoff work provides an interesting counter example.

The longitudinal evidence is similar. They examined, over a four year period, within-grade movements in relative pay and relative performance-rating. It was found that pay moves up but performance remains stable or deteriorates so, again, the growth in (relative) earnings is not explained by the growth in (relative) productivity.

Fuller (1976) used job performance, as rated by supervisors, in his study of millers, turners and grinders in India. He states that basic pay was sensitive to seniority (though there was only a small wage range for workers in the same occupational category). But he finds that job performance is negatively related to experience after controlling for other factors such as years of schooling and type of training. So, again, the pay-productivity profiles are ruptured.

It is interesting to note, in passing, that, unexpectedly, the pay-experience profile in the above two studies is positive and/or steeper than the productivity-experience profile. Another firm-level case study is by Ryan (1980). This too casts doubt on human capital theory, but in his firm the productivity profile is steeper than the pay profile. Ryan's (1980) study of arc welders in a US shipbuilding firm suggests that the experience-pay profile and the experience-productivity profile guarantees the firm the worst of all worlds. The company bears the cost of training in a transferable skill under conditions of high labour mobility. Theory predicts that the firm will experience a surplus of prospective trainees and a shortage of experienced workers. These predictions are confirmed. The company had between five and ten applicants for every vacancy. As Ryan comments "it is hardly surprising that a long queue faced a firm which offered the opportunity to learn a widely used skill without sacrifice of current income" and "it is unlikely that a lower level of trainee pay would have eliminated the excess supply of applicants". On the other hand, the evidence points to "the inadequacy of the supply of experienced welders" largely because the shipyard pay was in the lower part of the pay distribution in the local labour market. Even moderate values of the elasticity of supply would have permitted the shipyard to reduce the costs of its welding operations by raising the pay of mechanics (top welders), thereby effecting a more-than-compensatory saving on training.

Clearly in its training of arc welders this shipyard does not accord with the pay and productivity profiles over time - the sharing of training costs and benefits - predicted by human capital theory. (But it might be noted that, given the firm has got it wrong, subsequently the predictions of human capital theory are amply borne out. The firm bears the cost of the training and so is overwhelmed by the supply of prospective trainees. It tries to recoup the cost of its (general) training by paying below the going rate for that skill and so the skilled workers are very quit-prone). One reason that the firm has wrong pay/productivity profiles for welders is the constraint imposed by the internal labour market. Welders accounted for only 28 per cent of the hourly workforce. It was not possible to raise the pay of experienced welders alone because:

- customary differentials and status rankings would be overthrown by the adaption of welder pay to market conditions.
- any increase in the wage rate for welders would be highly visible because they move among many locations and work alongside a number of different trades.
- an increase in the pay of welders alone might have been acceptable if other trades could have switched into welding, but this was precluded by the high training costs.

In fact, Ryan concludes that the least costly strategy, if relative job rewards are indeed flexible, was to maintain the pay rates for skilled welders and bear the burden of welder training.

If data on inputs are available for a number of different plants a production function can be used to check on the marginal product - wage relationship. Thus Layard et al. (1971) found a divergence between the marginal product of labour and its wage in their study of plants in the electrical engineering industry. Again, this is important because if pay is used to calculate the social or firm rate of return the results may sometimes be misleading where pay and marginal product diverge.

5.5 Type of training and job performance/productivity

It is important to know not only how earnings are influenced by type of training but also how job performance is related to training. Two firm-level studies provide such information.

In the analysis of the job performance of miller, turners and grinders in a firm in India Fuller (1976) found that workers with in-firm training - both formal and informal - are more productive than workers from pre-employment vocational institutes, even when schooling, trade experience and socioeconomic factors are controlled for. He states that if the proportion of workers with organised in-firm training were increased from 48 per cent to 100 per cent there would be a 5.4 per cent gain in worker efficiency. Fuller also presents material on the interaction between schooling and training. There are two important findings. First, irrespective of schooling level, workers with in-employment training are more likely to achieve higher levels of performance than workers with pre-employment training. Second, extra schooling appears to be an important pre-requisite for on-the-job learning.

In their study of downtime on ships in the US Navy Horowitz and Sherman (1980) also discuss the training - productivity relationship. The acquisition of certain advanced skills confers Navy Enlisted Classifications (NECs) on individuals. Some NECs can be gained only by school attendance, others can be learnt on the job. Unfortunately they do not present detailed results. For boiler technicians there was clear evidence that the average number of school related NECs per technicians is strongly (negatively) related to downtime in both complicated two-plant 1,200 p.s.i. ships and one plant ships. On two-plant 600 p.s.i. ships NEC training was not related to downtime, but crew size was. This hints that, as we have come to expect, skilled labour is complementary to complex physical capital while less complicated physical capital often goes hand in hand with less skilled labour.

5.6 Summary

Firm level evaluations of vocational training have been neglected. This is a pity because they offer a fruitful area for such evaluations, as demonstrated by the high standard of the published firm-level studies. On the costs side it is fairly straighforward to measure the costs of formal training. It is possible, but difficult, to get at foregone earnings: though this may, in fact, be less of a problem than it initally appears because in many cases firm-level training may imply no foregone earnings. The most difficult cost element to measure is the cost to the firm from informal training because this requires a measure of net trainee output. On the benefits side a number of benefit measures have been used, including: job performance, downtime, reduced turnover and reduced input costs. If information is available on the costs and benefits of training for a sample of firms these can be combined via a production function although it seems unlikely, alas, that this method offers much scope yet for evaluating occupational training. In some cases information at the level of the firm is available for both pay and productivity. Human capital theory which underpins many training evaluations requires equality in the net present values of output and earnings over the duration of tenure an individual spends in the firm. Such pay and productivity information permits a test of the pay and productivity relationships, vital if earnings are used to evaluate training.

PART II

EXTERNAL EFFICIENCY OF VOCATIONAL TRAINING

SECTION 6

Earnings Based Benefit-Cost Evaluation of Vocational Training

The standard way of analysing the (external) efficiency of training programmes is via the use of earnings data. In this section I consider the objectives of training, the basic method of analysis, certain methodological problems that exist even if we assume earnings are a good measure of the value of output and the problems which arise when we relax that assumption. It must be emphasised that "studies based on earnings represent the black box approach to evaluation, they jump straight from training costs to money benefits and miss out trainee reactions, learning, job behaviour and organisational effects" (Drake 1982). We really need to go inside the black box and consider in detail, for example, *why* earnings rise with experience or *how* we can choose between instruction organised in different group sizes, expanded one way rather than another and substituting capital for labour (Selby Smith 1970). In what follows general principles are discussed first, then they are applied to the particular instance of vocational training at the level of the firm.

6.1 Objectives and methods

Training programmes have three general objectives (Ashenfelter 1979, Bloch 1979). First, they aim to eliminate shortages of skilled workers via upgrading from less skilled to more skilled status. Second, they aim to augment human capital thereby raising the earnings and probability of employment of the trainee. Third, they may be designed more on equity than efficiency grounds to alleviate poverty or to reduce inequality. Clearly the major aim of corporate vocational training is the first one - to overcome any shortage of skilled labour, though such training may also have the wider aim of augmenting human capital with a view to raising the earnings of the trainee. Presumably equity considerations are of minor importance in any training associated with World Bank projects. Each of these three objectives require the earnings of training participants to rise, therefore "evaluating the success of training programmes is thus inherently a quantitative analysis of assessment of the effect of training on trainee earnings" (Ashenfelter 1979 p.98).

Vocational training can be thought of under both a human capital and a segmented/internal labour market heading. Human capital emphasises the relationship between training and individual productivity: the social and private rate of return to the investment in training is essentially the increase in pay earned by a worker as a result of that training. Hall (1979) points out that there is no reason to expect a high rate of return to public training programmes (in a developed economy) because private investment in training should have equated the return to training to the market interest rate. Presumably World Bank training projects are required precisely because private markets have failed to produce the optimal amount of training. The segmented/internal labour market view emphasises that the benefits of training programmes arise from their ability to move workers from one labour market to another, which they are unable to do on their own. Such training can be thought of as increasing mobility between skills in the internal labour market of a firm.

Cost-benefit analyses of training using earnings can be done for the individual, the firm or for society. Typically the private individual is assumed to be mainly interested in the earnings increment associated with the training while the firm and society are interested in the extra output generated, where the value of the extra output is assumed to be adequately measured by earnings (this assumption is discussed at length below). There are five ways of evaluating a training programme using earnings data. The first three methods are given in Table 6.1. The other two methods are less familiar but very useful in the context of training. The five methods are:

- present value of net benefits
- rate of return
- benefit - cost ratio
- payback period
- earnings differential required for x% rate of return

Naturally the general formulas presented in Table 5.1 have to be translated into particular forms for training. Let us just take one example. Zymelman (1976 p.26) shows that the rate of return to in-plant training is given by solving the equation below for r:

$$\sum_{t=1}^{m} \frac{C_t+W_{at}-Q_{at}}{(1+r)^t} = \sum_{t=m+1}^{n} \frac{Q_{st}-W_{st}}{(1+r)^t}$$

where C_t = cost of training a worker over a unit of time t

W_{at} = wage rate of trainee during t

Q_{at} = value of production attributable to a trainee during t

W_{st} = wage rate of a skilled worker during t

Q_{st} = value of production attributable to a skilled worker during t

r = rate of return

t = time subscript

m = length of training period

n = length of time the skilled worker remains in the firm.

TABLE 6.1

Three evaluation criteria for evaluating public investments

Present value of net benefits: $\sum_{t=0}^{n} \frac{B_t - C_t}{(1+i)^t}$

Rate of return: $\sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t} = 0$

Benefit cost ratio: $\dfrac{\sum_{t=0}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=0}^{n} \frac{C_t}{(1+i)^t}}$

where B_t = total benefits in year t

C_t = total costs in year t

n = number of years spanned by the analysis

i = social discount rate

r = rate of return

Three decision rules:

1. Choose projects having the highest present values of net benefits; reject any project having a negative present value of net benefits.
2. Choose projects having the highest rate of return; reject any project that has a rate of return less than the social discount rate.
3. Choose projects having the highest benefit-cost ratios; reject any project having a benefit-cost ratio less than one.

Source: Bruce F. Davie and Bruce F. Duncombe, Public Finance, New York: Holt, Reinhart and Winston, Inc., 1972, p.83.

Particular issues such as how to get at the value of production attributable to trainees and skilled workers are discussed below. The payback period method is based on the present value of net benefits and simply asks how many years are necessary (i.e. what value of t) for discounted benefits of training to equal (discounted if appropriate) costs.

The required earnings differential is specially valuable when incomplete data on benefits exist. Say that a country wishes the investment to yield a 10 per cent rate of return, the formula is:

$$\frac{\text{Required differential}}{\begin{array}{c}\text{Training}\\\text{instruction cost}\end{array} + \begin{array}{c}\text{Foregone}\\\text{earnings}\end{array}} = .10$$

where data exist for the denominator and you solve for the numerator. This seems a particularly valuable way of thinking simply about Bank-financed training. Cost data will typically be available. The required return is presumably known by the World Bank or recipient country. The "required differential" for the trained person can then be compared with known facts about the pay structure to see whether investment in firm-level training, in general or in a particular form, is worthwhile.

Less than complete information on costs and benefits still permits helpful evaluations of the external efficiency of different types of training. Cost effectiveness analysis concentrates on the cost of achieving a given outcome. For example, if a certain amount of trained labour is required to work in a power station in a developing country is it more cost effective to get the trained labour from abroad or to undertake the required training locally? If the training is to be provided locally, cost effectiveness analysis indicates, for example, the relative merits of institutional versus firm-based training. There is no question of trying to estimate a rate of return to particular types of training. Cost effectiveness analysis is much more straightforward: it simply analyses the different costs of achieving a given objective.

6.2 Methodological problems

Making the assumption that earnings measure output satisfactorily, there are still a number of difficult methodological problems to be faced in any study which purports to calculate the cost effectiveness or rate of return (or other summary indicator) using earnings data. These problems include: sample size, the comparison group, the use of longitudinal data, and the impact of labour mobility on the estimates. Any evaluation of corporate training using earnings would need to consider each of these problems. The even thornier black box issue - whether earnings measure output - is discussed later.

Sample size

The sample size must be sufficiently large to obtain "small" standard errors of the estimated impact of the programme (cf. Ehrenberg 1979, Conlisk 1979, Stafford 1979, Pitcher 1979). The generally accepted procedure is:

- ask what level of programme benefits are required for the benefit/cost ratio of the programme to equal unity
- then determine the sample size necessary to allow us to estimate such an impact (if it exists) at any pre-determined level of statistical significance.

If the earnings variable has a high variance then, a large sample size is required to detect a small anticipated effect of the training. This may be less of an issue for corporate vocational training because the earnings variable will surely have less variance than, for example the variance is earnings among those who go through Government manpower programmes (and their comparison groups) in the U.S.

Control groups

The most controversial methodological issue concerns the control group. Consider these views:

> "... the principal methodogical division in effectiveness analysis is still the choice between assessing training effects by measuring attainments in an experimental and control group, and using one group as its own control ... At the level of the firm or the industry, most evaluators have been overwhelmed by the practical difficulties of a control group approach" (Drake 1982 p.119).
>
> "Evaluation research in the manpower area still remains as much an art as a science, with no well defined and generally accepted best practice ... There are some well-defined worst practices, however. For example, simple before after comparisons without any comparison group, are definitely frowned upon" (Ehrenberg 1979 pp.157-8).

Thus in corporate vocational training are the trainees to be their own control group by analysing their earnings before and after training or are their before and after earnings to be compared with those of a control group?

If we study participants only, by analysing their earnings before and after training, we may get spuriously large programme effects. In general, there are three reasons for this. First, with wage inflation, individual earnings tend to increase over time in nominal terms. Second, real earnings rise as workers gain experience with time. Both these reasons apply to corporate training. Third, the trainee may have transitorily low earnings immediately before training. This is likely to apply in the case of public manpower programmes which take unemployed people but is less relevant for corporate training, which will often be designed for current employees.

Where do we get the comparison group to ensure that general changes in earnings are not taken to be the effects of training? In a classical sample design some fraction of a training programme's applicants would be randomly assigned to training while the remainder would be reserved as a comparison group. This can only be done if there is an excess supply to the training programme. Possible alternative controls include what Bloch (1979) calls "partial programme participants" such as individuals selected for the training but who did not show up to take it (no-shows), drop-outs, interested non-enrolees and qualified non-applicants.

Alternatively, the trainee and comparison groups can be drawn from different populations, then we control statistically for differences between the two groups. To do this we need to specify an earnings function that would prevail for both groups in the absence of the training programme. For example Keifer (1979) specifies the following earnings function:

$$y = b_0 + b_1 \text{ Age} + b_2 \text{ Education} + b_3 \text{ Marriage} + b_4 \begin{array}{c}\text{Training}\\ \text{participant}\end{array} + b_5 \begin{array}{c}\text{Training}\\ \text{weeks}\end{array}$$

Keifer ran this for 3 quarters before training and 3 quarters after training. The impact of training is the coefficient b_4 which indicates whether or not the individual has participated in the training programme plus the coefficient b_5 evaluated at mean weeks of training. Thus he ends up with information like this:

	Quarters before training			Quarters after training		
	3	2	1	1	2	3
Pay differential: those with over those without training ($b_4 + b_5$)	dollars			dollars		

In a related paper (Keifer 1979a) confirms that this sample must include training and non-training individuals and must span pre-training and post-training periods. Evaluation results will be "misleading" if the returns are estimated only from (i) a post-training comparison of earnings between trainees and non-trainees or (ii) a before-after comparison of earnings of trainees alone.

It is straightforward to use the results from the quarters after training to do an inverted cost-benefit analysis. Say the cost of training per participant is $1,000. Therefore an annual $100 perpetual earnings differential is required for discounted benefits to equal costs using a discount rate of ten per cent. We can then examine the pay differential associated with training to see if the required differential is achieved. It would be a straightforward matter to do this for Bank-financed corporate training.

There are a number of problems with these earnings functions. First, the maintained hypothesis is that the earnings generating functions are of the same form for the trainees and the comparison group (Ashenfelter 1979). Second, it is possible that, in the jargon, participation in training is endogenous: we require training to be the cause of the rise in earnings rather than a decline in earnings being the cause of entry into the training programme. Third, the functions are normally linear, but need not be. Probably none of these problems are particularly important for corporate training.

The comparison between the control group and the trainees need not be done via a statistical analysis using individual data. Instead the earnings of the two groups can be averaged and comparisons made between these aggregate profiles (cf Colley et al. 1979).

Not all studies, of course, use a separate comparison group. Rather the control group can be the pre-programme participants. Kaitz (1979), for example, uses no controls but instead presents a Markov process of the pre- and post-programme labour force experience of the trainees. Ideally, an evaluation of corporate training using earnings data would use a control group but the before/after method using longitudinal data would probably not be very misleading especially if the trainees are current employees of the firm.

Longitudinal data

For many employment and earnings problems "observing the characteristics of a given individual at different points in time has considerable analytical advantages" (Psacharopoulos 1981 p.744). In particular other things are held equal, true lifetime profiles can be constructed, vintage effects of education and training can be controlled for, and the impact of a particular labour market state (say whether unemployed) on future states (say future unemployment and sickness) can be examined. In the particular case of training longitudinal data are specially valuable. It is necessary to track trainees over long enough time to measure the full intertemporal impact of training to see how rapidly the impact depreciates, or appreciates, with time. Earnings depreciate if training does not permanently alter the capability of the individual but simply has a placement effect. The effect appreciates over time if training allows individuals to qualify for jobs which offer investment opportunities, in which case the trainees post-training earnings will be temporarily low and then grow rapidly over time, perhaps due to promotion. Another way of thinking about this is to say that training has a permanent effect due to the increase in human capital and a transitory effect, due to placement, which will disappear after a few years. Johnson (1979 p.249) makes this point vividly: "The use of observed earnings during the first year after the programme is about as reliable as choosing from a table of random numbers" and the problematic nature of immediate post-training earnings is confirmed by Gay and Borus (1980).

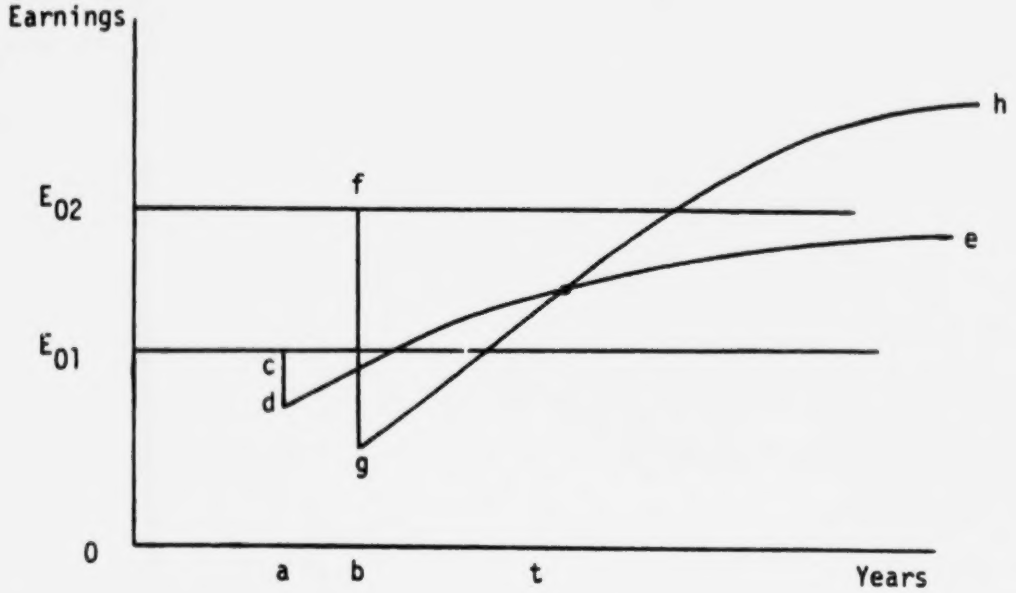
The importance of earnings data on trainees and a comparison group both before and after training was emphasised in Section 3. In the absence of an experimental design where individuals are randomly assigned between trainee and control groups the process of selection into the training programme may be highly correlated with unobservable factors which also help determine earnings. This can be overcome in either of two ways if longitudinal data are available. First, a fixed effects model estimates an earnings function prior to training and an earnings function post training and then differences them. This causes the unobservable factors to net out leaving the change in earnings pre/post training to be a function of participation in the training programme. The second possibility is what is called an autoregressive model. In this case pre-training earnings are used to capture the unobservable factors which influence pay. Again, this makes it more likely that the pure impact of training on earnings will be captured. By contrast, if no longitudinal data exist it is less likely that the investigator will be able to calculate this pure training participation effect.

In general, of course, longitudinal data is not available. This raises interesting practical and theoretical issues for training evaluations. Cohen (1983) overcame the problem by constructing his own longitudinal data. In his study of industrial training in Malaysia he had information on post training earnings and on the average earnings of skilled workers. He simply assumes that it will take twenty years for the earnings of the newly-minted trainee to reach the level of the skilled worker. In calculating the corporate rate of return he then uses the wedge between the (gradully rising) earnings of the trainee and the higher (stable) earnings of the skilled worker as the measure of the benefits of training. It would certainly be possible to replicate this method in any corporate training study. But there is a real problem with the hidden assumptions in Cohen's method. It is not clear how the firm is able to pay the individual below his/her value to the firm for as long as twenty years. Surely the individual would quit in these circumstances. Cohen's method is only legitimate if training is truly specific. Note that the method of construction of the longitudinal data affects the private and social rate of return as well as the corporate rate.

The theoretical issue is described in Figure 6.1 (see Levine (1979) for an application of this to Israel). Individual 1 has less years of formal schooling/training than individual 2 and "invests" less in on-the-job training i.e. the gap between actual and potential earnings on entry to the labour force is small for individual 1 and big for individual 2. If we have no longitudinal data, we may observe earnings at t which might (for example) be 4 years after entry to the labour force for individual 1 and 3 years after entry for individual 2. Just at that point actual earnings are identical, therefore in an analysis we would observe non-significant effects on different training lengths/methods. But the present values of the earnings streams could be very different: either individual 1 or individual 2 might have a higher present value of stream of future earnings. Thus if we have no full longitudinal data we are liable to reach wrong conclusions on the efficiency of training duration and methods.

FIGURE 6.1

Cross section compared with longitudinal earnings



E_{01}, E_{02}	potential earnings of individuals 1 and 2
Oa, Ob	formal schooling of individuals 1 and 2
cd, fg	investment in on-the-job training by individuals 1 and 2
t	time the cross section earnings are observed (so-called crossover point)
de, gh	earnings streams of individuals 1 and 2

One way to get longitudinal data is by tracer or follow-up studies. In her recent survey of such studies Hilowitz (1983) concluded that they "are an important supply-side-instrument for assessing the effectiveness of existing training programmes and modifying them in response to signals from the labour market or for planning new programmes" (p.3). The design of such follow up studies needs careful thought (cf Morell 1979). Essentially they can either follow one cohort for a considerable period of time or they get information at a single point in time on more than one cohort of past training graduates. At least six States in the US use local follow-up evaluations of vocational programmes for state level planning (see for example Brown and Kiefer 1980). Tracer studies generally collect longitudinal data on earnings but Holowitz lists many other indicators of the outcome of training programmes: employment rate; length of waiting time before first job is found; job mobility; degree to which training is actually used on the job; employer satisfaction with the trainee; general integration of graduates into the labour force; graduate attitudes toward the training programme; and attitudes of programme administrators and teachers regarding trainee performance both during and post-programme.

Labour mobility and training completion rate

The individual is simply interested in his training costs and benefits. But if we estimate the social or corporate rate of return other matters need to be considered. First, not everyone will complete the training. For example Borus (1977) reports the following completion rates for different modes of vocational training in Israel:

	% of entrants graduating
short courses	85
industrial schools	80
vocational secondary schools	67
apprenticeships	55

Thus costs to the firm and to society should reflect the costs incurred on behalf of those who do not complete.

On the benefit side there is also the issue of labour mobility, among firms, occupations and even countries. For the corporate rate of return the retention rate of trained labour is crucially important. For given costs incurred by the firm, the return will be higher the longer the firm is able to gather the wedge between the value of output produced by the trainee and what it pays him. For example, Thomas et al. (1969) found that three quarters of the benefits of a systematic new training system inside a textile firm came from reduced labour turnover and only one quarter from higher productivity. For society it matters less how long the individual stays in a particular firm. But if he switches firms it does matter whether he is in the same occupation - whether the training is actually being used (though if it is not being used it is a complicated matter to adjust benefits). If the individual migrates outside the country the social returns to the training will naturally be lower, but even here the issue is not straightforward. Thanks to training, he might migrate from a low wage country to a high wage country and the currency remittances to the original country could be scored as a benefit.

6.3 Earnings and output

Drake (1982) stated " ... measuring the contribution of training to effectiveness at work has frequently baffled investigators. Some have fallen back on the heroic assumption that wages are an approximate but sufficient measure of the productivity of trained manpower ... ". The methodological problems discussed above exist even if that heroic assumption holds. But does it? There are (at least) three sets of reasons why earnings may not measure the value of output. First, non-competitive or non-compensating factors may influence pay structures. Second, externalities drive a wedge between private and social values. Third, the labour market may not be in equilibrium. Each set of reasons will be examined in turn. If (differences in) earnings cannot be justified on efficiency grounds then labour may get mis-allocated and estimated social rates of return may not always be correct.

Non-competitive labour market

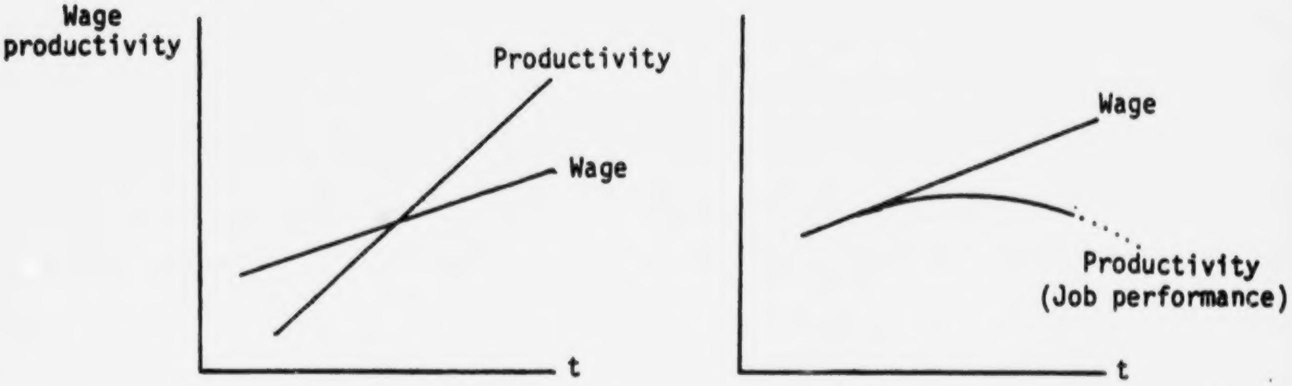
Orthodox competitive theory has been challenged in recent years by the twin concepts of segmented and internal labour markets. Both these concepts are important to us. Under the internal labour market, the firm sets its own pay rules, possibly insulating the employees from the external labour market. Under the segmented labour market individuals who work in so-called primary firms - with for example large plants, high capital : labour ratios and high unionisation - may earn more than those who work in the so-called secondary segment of the labour market. Four dimensions of non-competitive labour markets are analysed: the relationship between pay, productivity and experience; the role of ability-to-pay factors; discrimination; and administered labour markets.

Pay - productivity and experience. There are many possible reasons why pay rises over the lifetime of an individual, independent of real earnings growth (cf. Brown 1983). First, under the human capital theory pay mirrors productivity and productivity depends positively on schooling or post-school training. And post-school training diminishes over time because of the finiteness of life or because of rising opportunity costs. On this theory wages increase with experience. Other theories play down the spot equality between wages and productivity. For example Lazear (1981) suggests that the earnings profile may rise more steeply than the productivity profile to discourage malfeasance (shirking) among workers. Alternatively the pay and productivity profiles may diverge to discourage "movers" from seeking employment in the firm. Another possibility put forward by Harris and Holmstrom (1982) is that the steeper wage profile may reflect implicit insurance arrangements between workers and firms in which ex post wage increases are related to ex ante productivity but are uncorrelated with ex post productivity within skill groups.

The work reported in Section 5 by Fuller (1976), Medoff (1981), Medoff and Abraham (1980) and Ryan (1980) attempts to test the underlying assumption of human capital theory that earnings measure value product (see Figure 6.2). Medoff found that within-grade pay was positively related to experience but there was no such relationship between productivity and experience. His productivity measure was job performance, as assessed by the supervisor. Ryan found that the wage-experience profile for arc welders in a US shipyard was flatter than the productivity-experience schedule and welders - a general skill - had, not surprisingly, high post-training quit rates. (Although this clearly conflicts with the predictions of human capital theory some care is

FIGURE 6.2

Pay and productivity: two case studies



Arc welders in a US shipyard
Ryan (1980)

Large US Corporation, within grade
Medoff (1981)

needed in interpreting Ryan's results. The firm, apparently, was aware that it should, essentially, have a steeper pay profile in order to retain its welders. But higher pay for skilled welders would have disrupted the (horizontal) pay differentials between welders and other skilled craftsmen. In one sense therefore, given that the pay structure forces "artificially" low pay for skilled welders the prediction of human capital theory is therefore confirmed). Any evaluation of corporate training must attempt to check whether pay is an adequate measure of the value of output. If it is not then both the corporate and the social rate of return will be either overstated or understated.

Recently Brown (1983) has suggested that there is evidence that may indicate a substantially greater role for on-the-job training in explaining wage growth than that suggested by the Medoff and Abraham study. This evidence is contained in the Michigan Panel Survey of Income Dynamics, which in Waves nine (1976) and eleven (1978) asked respondents the following question: "On a job like yours, how long would it take the average new person to become fully trained and qualified?". Using the answer to this question along with corresponding information on tenure in current position, it is possible to identify those employees who are currently in training, as well as the cumulative time spent training for each employee. This information permits more precise measurement of differences among individuals in the extent of on-the-job training and its effect on wages. If explanations of wage growth that do not rely on the growth in productivity associated with more human capital are correct, then we should expect to observe wage growth after the point in time when people become fully trained in their current positions. Alternatively, if the human capital on-the-job training model is correct we should expect to observe wage growth associated with training. The potential relevance of alternative models in explaining lifetime wage growth might therefore be judged according to the fraction of observed wage growth explained by on-the-job training in comparison with the fraction that remains for other factors. Brown finds that there is very little discernable wage growth in the absence of training. Of the wage growth that is observed during or on completion of training, only a small part appears attributable to factors other than training. In the Michigan Panel Survey data, individuals' wages typically increase over time either through promotion to a higher-paying position, which also involves training. Within a given position, however, individuals experience very little, if any, wage growth after their training has been completed. Further, training appears to have effects on wages that are comparable to the effects of schooling. Brown concludes "Thus, these data suggest that on-the-job training plays an important role in determining wage growth. The data also suggest that models which imply wage growth subsequent to training have little such wage growth to explain, and so are probably not relevant to the data" (p.7). Essentially what Brown is saying is that the Medoff and Abraham result refers to a particular case study and does not hold up with a much larger sample. However, for the human capital model - clearly favoured by Brown - to be fully validated it is also necessary that training raises productivity. It is quite possible that, instead, the training period is nothing more than a testing or probationary period. To confirm the human capital model it is necessary to show that the present value of the productivity profile associated with training is coincident with the present value of the wage profile. This is something we know rather little about.

Psacharopoulos (1983) examined the relationship between pay and productivity - related characteristics separately for the private sector and public sector across six countries (UK, Greece, Portugal, Brazil, Colombia, Malaysia). The effect of education on earnings is stronger in the private sector, a finding "to be interpreted as a recognition of the high productivity of the educated where profit matters" (p.128). Thus in the private sector "the education level seems to have a productivity counterpart" but such an association is, by implication, less evident in the public sector. Therefore evaluation of vocational training using earnings may be more difficult the larger the number of public sector employees in the sample.

Ability to pay. Three recent studies of developing countries which throw light on the issue of whether pay reflects competitive factors such as schooling, experience, training or non-competitive ability to pay factors such as (other things equal) capital intensity, concentration, firm size, unionisation and per se foreign ownership are analysed. The results are summarised in Table 6.2. In the Kenya and Malaysia studies the relevant pay structure is inter-firm or inter-industry and pay across firms or industries is regressed on various characteristics of these firms or industries. The Tanzania study, by contrast, focusses on the determination of individual earnings. Knight and Sabot (1983) use 1971 pay information on 660 employees in 24 manufacturing firms to estimate an earnings function for Tanzania. They find that at least 87 per cent of the total explained variance is accounted for by the (competitive) personal variables such as schooling years and experience. The variables which capture the characteristics of the firms the individual's work in are much less important in explaining earnings than are personal characteristics. Nevertheless,

TABLE 6.2

Factors associated with earnings in the manufacturing sector in three developing countries

Country (author, year)	Observations	Variables significantly associated with earnings	Variables not associated with earnings	Remarks
Tanzania (Knight & Sabot 1983)	660 individuals in 24 firms	Education Experience Occupation Formal training Sex Race Age Firm size + Skill mix + Unionisation - Foreign ownership +	Capital intensity Profitability	Personal variables account for around 90% of the variance explained
Kenya (House & Rempel 1976)	100 wage contacts in firms, unskilled labour	Concentration + Plant size + Profitability +	Unionisation	Possibly the 3 significant variables proxy foreign ownership
Malaysia (Lim 1977)	350 establishments	Capital intensity + Capacity utilisation + % paid monthly - (Foreign ownership) +		Foreign ownership only significant in gross wage equation which include fringe benefits, not in net wage equation

some of these firm variables are significantly associated with individual pay: firm size, the skill-intensity inside the firm and foreign ownership are all positively related to pay, while unionisation is associated with a lower level of pay. Two other variables included to capture ability to pay - capital intensity and profitability - were not associated with individual earnings. This all leads the authors to conclude that "the evidence basically supports the competitive labour market paradigm (but) the market is by no means perfectly competitive" (p.64).

The Kenya study examined the wage contracts of unskilled labour in some 100 firms around 1970. There is clear evidence that ability to pay factors play their part: concentration levels, plant size and profitability are all positively related to earnings, though the degree of unionisation in the firm is unrelated to pay. The authors speculate that the three significant ability to pay variables may be picking up the effect of foreign ownership. However, it is also possible that profitable, large firms in concentrated industries have a far more skilled labour force. Thus it is not possible to conclude definitely that pay does not measure the true value of the individual to the firm or to society although there is a hint that this is the case. Such evidence is certainly in line with that of the ILO (1972) which, drawing on the notion of the segmented labour market, emphasised the rigidity of the Kenya pay structure and its failure to respond to growing supply pressures. However, a recent study (Collier and Bigsten 1981) has suggested that the ILO were wrong. The authors argue that despite a substantial increase in the demand for labour real wages fell very rapidly in the mid 1970s " ... the conclusion which emerges is the flexibility of the labour market ... The view that real wages are rigid is simply wrong" (p.43). If this latter study is definitive then any evaluation of training using earnings data is quite in order and will not be misleading on this score. But if the ILO and House and Rempel studies are correct great caution is required if such earnings information is used.

Lim (1977) studied the inter-firm and inter-industry pay structure for the manufacturing sector in Malaysia. He had pay data for 350 establishments. For part of his analysis he aggregated this firm-level pay information to 4-digit (n = 59) and 3 digit (n = 28) industry-level. Lim was particularly interested in whether foreign companies pay higher wages than their local counterparts in Malaysian manufacturing. And, if so, whether this is because they employ workers of higher quality or because of foreign ownership per se. Lim had two wage variables, basic hourly pay, and gross hourly pay which includes fringe benefits like subsidies on food, transport, clothing and medicine. 191 of his establishments were entirely Malay owned, 117 are entirely foreign owned and 42 have mixed ownerhsip. Essentially Lim found that the amount of capital and its utilisation were the factors most importantly associated with basic pay and he suggested that these are characteristics associated with foreign ownership. However, such capital-intensive firms and industries will probably need high quality labour and he was not able to control for the skill composition across his sample. When he examined gross pay he found that foreign ownership conferred a pay differential of around 10 per cent even controlling for the other factors like capital. This hints that any evaluation which failed to take account of the foreign ownership-earnings relationship might overstate the benefits of training.

Clearly, it is not possible to generalise on the basis of three studies. It seems likely, however, that competitive factors play a key role in determining earnings but that, in addition, ability-to-pay factors play their part. Although evaluations using earnings are unlikely to be misleading thought needs to be given to the errors which creep in if ability-to-pay factors are important.

Discrimination. If (say, comparing a man and a woman) productive characteristics are identical but earnings are different this suggests that pay is not properly measuring economic worth. (If male pay is greater than female pay we do not know whether male pay is overstating economic worth or whether female pay is understating it). Recently there has been a revealing study of the distribution of individual earnings among nearly 1000 individuals by race and by sex in Tanzania (Knight and Sabot 1982). The authors considered three sets of factors which influence pay between sex and race group:

- productive personal characteristics like schooling and experience
- differences in pay within an occupation, holding personal characteristics constant
- differences in occupational attainment, holding characteristics constant

The premium paid to males is explained almost entirely by differences between males and females in economic characteristics. Men and women with the same level of education, employment experience, formal training and other personal characteristics receive roughly the same pay.

But the findings on race are contrary to what one might expect. After standardising for differences in economic characteristics Asians earn a net premium in excess of the mean wage of Africans. This is not because the authors understate the productive characteristics of Asians - they earn the largest premiums in the manual occupations where unmeasured human capital is likely to have the least impact on productivity. If such results are typical any study which used earnings to measure the value of output would be misleading.

Administered labour markets. In Bank-financed training the firm will often behave as if training is specific and they will pay administered wages. But sometimes the trained person will leave to use his or her newly acquired skill in another firm, implying the training is general. Such an administered pay system implies non-competitive pay determination and, therefore, less correspondence between pay and productivity than occurs with competition.

The four dimensions of the non-competitive labour market suggest that the results of training evaluations may sometimes be imprecise if earnings are used to measure the value of output. The first dimension, the pay-productivity-experience nexus inside the firm is probably the most pressing problem. This is because in any before and after study (with or without a separate control group) a person is likely to be paid too much or too little on grounds of ability to pay of discrimination both before and after training. Thus the "after" earnings of the more skilled person may well reflect the impact of training as compared with the "before" earnings of the less skilled person. However, the first problem may well be ubiquitous: we simply do not know what goes on inside the black box and it emphasises the key importance of an understanding of the internal labour market in any evaluations including, for example, analysis of the vertical pay structure between skilled and unskilled workers in the same craft and the horizontal structure among different crafts.

If these non-competitive factors are held to dominate pay structures a different approach to estimating corporate and social rates of return is, conceptually, possible to estimate the rate of return to training. A cross section production function using plants as the unit of observation can be estimated including a number of different indicators of labour equality. The marginal product of these different labour types can then be calculated and those estimates can be used to calculate the corporate and social rate of return. However, this approach is difficult. First, cross section data on a number of plants is needed, bringing with it profound aggregation problems. Second, it is unlikely that more than two or three types of labour can be included in the production function and such an aggregate treatment of different labour types rather defeats the purpose of estimating the production function.

Externalities

Externality questions have bedevilled attempts to estimate the social rate of return to Government manpower programmes. There are two particularly important sets of problems. First, how displacement, replacement and complementarity are to be handled. Second, and flowing from the first, how the shadow price of labour is to be treated. These will be considered in turn.

Displacement, replacement and complementarity. Displacement and replacement affect the social rate of return but not the corporate or private return to training. Displacement occurs when a well paying job that is filled by a recent graduate of a training programme might have been filled by someone else. Thus the training programme participant displaces an incumbent member of the relevant labour market. In this case the observed earnings of the trained person less the observed earnings of a randomly selected control group person represents an overstatement of the actual increase in total output due to the programme - essentially all the programme achieves is a reshuffling of available job opportunities. Presumably displacement ought not to occur under Bank financed corporate training. The very purpose of such training is because there is insufficient labour of the requisite skill-type and therefore the trained person is not displacing anyone else.

Replacement occurs when the removal of the trainee (to be trained) has no opportunity cost because the job vacated is now filled by someone else, who may have been unemployed - so there is no loss in output in the economy as a whole. In this case the social rate of return to the training can be greater than the private rate of return. In much corporate training replacement in the sense described will not take place, but there are related problems. Certainly there may be no loss in output or in earnings while the individual is undergoing training. Further, if the trainee gets promoted he vacates a job lower down and ultimately such a trickle-down process may lend to a previously unemployed person being hired. Thus the replacement question needs careful thought in any social rate of return analysis of corporate training.

Complementarity occurs when solving one skill shortage permits employment elsewhere to rise when previously it had been held back because there was insufficient skilled labour. This will affect the corporate as well as the social rate of return.

Shadow price of labour. When we compare in plant apprenticeship training with vocational schools in terms of social costs, typically the foregone earnings of those who attend vocational schools are scored larger than foregone earnings of the apprentice. But if there is a large pool of unemployed labour should we score the foregone earnings of both apprentices and those who attend vocational school as zero? If so, then current practice overstates the cost differential associated with vocational schools compared with informal or formal apprenticeships. (A related problem concerns the cost of instructors on or off the job. If they have very scarce local skills then their cost may be undervalued). This issue is relevant to calculating the social rate of return to firm-level training but need not concern us if we are only interested in the corporate or private rate of return.

Disequilibrium

Even if the labour market is competitive and there are no externality problems, calculated rates of return might still be inexact for (at least) two reasons. First, the rate of return may be temporarily high (low) because of excess demand (supply) of labour in the occupation. Second, even though present values of earnings and contribution to output may be identical over the tenure of the individual inside the firm, they may not be identical at any point in time. These are considered in turn.

Labour shortages. A very high rate of return may simply reflect a shortage of labour in that particular occupation. Of course, this is the reason for doing the training and once the supply of labour has adjusted the rate of return will fall. This is sometimes (wrongly) held as a criticism of using earnings to evaluate training. Rather, the criticism can be inverted: the rate of return is a test of whether the labour market is in equilibrium. A narrower version of this problem occurs if aggregate employment increases rapidly in a country. This might raise the relative and absolute pay of apprentices temporarily and a study done at such a time would show high returns to apprentice training compared (say) with vocational school training, but such high returns would only be transitory.

Present values versus cross sections. The human capital model essentially predicts equality (on average) between the present value of earnings and of marginal products over the duration of tenure in the firm. But there need not be equality at all points in the profiles. For example with firm-specific training pay may exceed value product during training and vice versa later. Or if the aim is to cut labour turnover the pay-experience profile may be steeper than the pay-value product profile. Therefore, for any individual pay may certainly not measure the value of his output at a point in time which may cause problems for the social and corporate returns. But, if there is an adequate sample of individuals by experience the positive and negative wedges between pay and output should average themselves out, so minimising this problem.

Non-competitive labour markets, externalities and disequilibrium each counsel caution if corporate or social rates of return to vocational training are calculated using earnings data. As Hilowitz (1983 p.42) puts it " ... if earnings levels are used as a proxy for the graduate's productivity and his usefulness to his employer (and to society) this must be done in a limited context where the underlying assumptions are carefully stated ... Too often facile and unstated assumptions have lead to facile calculations of dubious significance".

6.4 Summary

The external efficiency of training programmes is frequently evaluated using earnings data to calculate the private, social or corporate rate of return. There are a number of thorny methodological problems associated with such calculations. First, is there to be a control group or is a before/after analysis of training sufficient? Second, it is necessary to track trainees over a long enough time to measure the full inter-temporal impact of training to see how rapidly the impact depreciates, or appreciates, with time. But unfortunately such longitudinal data are seldom available. Third, rates of return or benefit - cost ratios must be corrected to control for drop-outs during the training and labour mobility after the training.

Even if these methodological problems are overcome there is a more fundamental economic problem. The evaluations based on earnings assume, implicitly or explicitly, that earnings are a good measure of productivity. But this may not always be so. First, labour markets may be non-competitive. Under internal labour market regimes in many large corporations experience-pay profiles may diverge from experience-productivity profiles. Ability to pay, represented by profitability or monopoly power in the product market for example, and discrimination may also drive a wedge between pay and productivity. Second, externalities may be pervasive. Although the standard displacement and replacement problems may be less severe in corporate training than in public training programmes, it is plausible that training raises output of other labour than solely the trainee. It is particularly difficult to measure such an effect. Third, the labour market may be in disequilibrium. Labour shortages or surpluses may exist (though this does not, as is sometimes asserted, invalidate rate of return analysis). Further, there is no reason to expect equality between pay and productivity at all points on the experience profile. Thus *even though cost-benefit analysis is the superior method of evaluating training*, any such evaluation based on earnings data should be tentative in drawing its conclusions.

SECTION 7

Output based and other evaluations of firm level vocational training

In addition to the use of earnings data to evaluate the external efficiency of vocational training it is also possible to use output and input measures. In any before/after study or paired comparisons the unit of observation for measuring output or inputs can either be the individual or the plant. Measures of individual output include piecework earnings, performance rating and quit propensities. Plant output and input measures include downtime, physical units of output, the value of output and the cost of inputs. In what follows we discuss: methods of evaluation, measurement of output and input, and cost-benefit analysis.

7.1 Methods

Potentially, there are three ways to analyse the impact of training on output or input. First, a single plant can be studied over time. The output (however defined) or input prior to training can be compared with post-training output. Naturally, other factors which also influence output must be taken into account. In this method the "control" is the plant pre-training and the "experimental" is the plant post-training. Second, twin plants could be studied where the twins are, if possible, identical in all respects except that one has training and the other does not. The output of the twins can then be compared. Third, and much more complicated, a large cross section of plants in a particular sector might be used to calculate a production function relating inputs to outputs. Any attempt to isolate the impact of training via such a production function would be like searching for a needle in a haystack. Although this production function method is "best practice" we can get a long way using short cuts, for example by examining the change in labour productivity associated with training after controlling for any change in the capital input. Let us spell out, briefly, why a World Bank study designed to get at the impact of training should (for the time being) use the simpler before/after or twin methods rather than attempt a full production function approach.

There are a number of general problems associated with estimating production functions from a cross section of plants. Further, there are particular problems when the focus of attention is the impact of trained labour on output. The general problems include:

- sample size: the problem here is to balance the increasing size of the sample against the increasing heterogeneity of the plants in the sample.
- heterogeneity of the output: if different plants produce slightly different outputs how are we to cope with this heterogeneity? In fact this may be a minor problem for World Bank-financed training because many Bank projects involve quite homogeneous output like electricity supply and road miles.
- should output be measured gross or net?
- how is capital to be defined and measured?
- the production function approach assumes that across plants the production technique differs only by a scale factor. In fact, production techniques (e.g. capital to labour ratios) differ among plants.

Even if these problems are solved there are (at least) two further interrelated issues if the focus is the impact of trained labour on output or inputs. First, trained labour will normally account for only a small proportion of total costs, therefore many of the other factors affecting efficiency drown out the effects of using less and more trained workers. For example in electricity supply capital surely mainly determines output across power stations, so it would be difficult to estimate the separate contribution on trained labour. Second, and related, how dis-aggregated should the labour input be? The most sophisticated study so far (Layard et al. 1971) started with labour split into five skill categories but even when the labour input was aggregated to two categories no association between skill and output could be detected.

It is a pity that the production function approach is likely to prove difficult if the aim is to see whether, and to what extent, vocational training influences output. If it worked it would provide two pieces of invaluable information. First, the marginal product of skilled labour could be calculated. This indicates the (short run) value of output produced by one extra unit of skilled labour. In turn, this estimate can be compared with the unit cost of training and a corporate or social rate of return to such training can be calculated. Second, the production function approach permits an estimate of the elasticity of substitution between different types of labour and between labour and capital. This elasticity estimate indicates the (long run) impact on factor prices (e.g. the wages of skilled to unskilled labour) as their relative supplies change, or alternatively, how production techniques change in the face of a change in factor prices.

Although the production function approach is too ambitious, at this stage, to analyse the impact of much World Bank vocational training it is worth pointing out that such an approach has proved useful at both a higher level of aggregation and in the agricultural sector. Medoff (1982) examined the relationship between U.S. manufacturing output at the 2-digit industry level by state and two training variables, controlling for inputs of capital and labour. The training variables refer to "employer-sponsored job related" training (ESJRT). There appears to be no relationship between out-of-house training and labour productivity, but training received at the place of work has a positive impact on productivity. There have also been a number of studies of the relationship between farmer education and farm efficiency. In such studies output is related to capital, labour, education levels, extension training and so forth and the sample is either individual farms or areas (for a comprehensive survey see Lockheed, Jamison and Lau 1980). In Indonesia a World Bank training project has introduced some farmers to new irrigation techniques. It would be possible to use the production function approach to compare the output of farmers using new techniques with those using more traditional techniques.

One ingenious use of cross section data to get at the returns to training, but without estimating a production function, is by Mingat (1984). The sample was 52 worldwide agricultural projects supported by the World Bank in the early 1980s. The output measure was the ratio of the actual rate of return of the project to the expected rate of return. This measure was related via regression analysis to training costs, technical assistance costs, per capita GNP, adult literacy rate and region. The findings are clear. First, the return to project related training is very high, possibly over 200 per cent. Second, the returns to training are bigger the higher is the adult literacy rate in the country. Although this method of evaluating the external efficiency of training would not necessarily be appropriate if the aim is to examine the extra output associated with training for any one particular project it does provide a valuable framework for analysing the overall efficiency of training to see whether in general, project related training should be expanded or contracted.

7.2 Measures of output and input

Ideally any before/after study or paired comparison study relates the value of the extra output or smaller input associated with training to its costs to get a rate of return to training. But it may not be possible to do this. First, if a plant-based measure of input or output is used many such measures are expressed in physical units that do not translate easily to a money value. Second, if individual-based output measures are used how is the teamwork problem to be overcome? It is very difficult to trace output to particular individuals. The problem has been described thus " ... in most cases where project-trained persons work along with either untrained persons or persons trained under some non-project programme it becomes impossible to identify separately the impact of the project-supported training" (World Bank 1982, para. 5.01).

Five possible measures of training output which are individual based and do, explicitly or implicitly, relate output to particular individuals are: (i) piecework earnings, (ii) performance rating, (iii) earnings growth coupled with performance rating, (iv) turnover and absenteeism rates, and (v) the ability to pass a Government trade test. The first two are, potentially, the most fruitful measures. The last two are illuminating but hardly central to training associated with Bank projects.

Piecework earnings are presumably related to output (though, given the variety of piece payment systems, the relationship is not necessarily linear). Thus piece-earnings provide a bridge between the previous section on earnings-based evaluations and this section on output-based evaluations. It may be noted that piece-earnings are the only individual-based output measure which permits a money cost-benefit calculation. The other individual-based output measures only permit cost effectiveness calculations. Let us say a few words about each of these.

Performance rating by supervisors was discussed above. In a before/after study, as long as the individual returns to the same grade, this provides a ready made indicator of the effectiveness of the training (assuming we are content that the rating accurately measures performance). If the individual undergoing the training gets promoted it is then not clear how to use the rating as a measure of cost effectiveness because his work is then intrinsically more responsible or difficult.

One way to test for the impact of training in a before/after study is to use individuals in the firm(s) where the project is being undertaken as the unit of observation in a regression analysis. The left hand side (dependent variable) is the change in piecework earnings or the change in performance rating over a period prior to and after training. The right hand side (independent variables) include exposure to training (one or more variables in dummy (yes/no) form) and various personal characteristics indicates the impact of project related training on piecework earnings or performance rating.

Alternatively, if we had before and after individual information on the change in earnings (any earnings, not just piece rate earnings) and performance rating we could do the following. Put the change in earnings on the left hand side. Run the regression initially with just training variables and personal characteristics on the right hand side. Next, introduce performance rating (which should itself be positively related to earnings growth). If the estimated coefficients on the training variables are reduced by the introduction of the performance rating, this indicates that training is positively related to performance (see Medoff 1982 for an application of this technique and some extensions).

If training reduces the *quit propensities* of the labour force this influences the duration of any benefits associated with training. In one of the few firm-based studies (Thomas et al. 1969) the reduced labour turnover associated with training had a far larger beneficial impact than the direct output increase. It would be a straightforward matter to calculate quit rates before and after training or between twin plants with and without training.

Some countries operate *public trade tests* for occupations like car mechanic or carpenter (Godfrey 1977). To the extent that training relates to occupations covered by the trade test the pass rate of those undergoing such training could, in theory, be used as a cost effectiveness measure. In general, however, Bank-financed training and trade tests are not coincident and there is probably not much scope for such cost effectiveness studies.

Plant-based output or input measures, while not permitting us to relate output to individuals, are more promising if the aim is to calculate a comprehensive cost-effectiveness or cost-benefit indicator of firm level training. It is probably better to work with an output measure rather than with labour productivity because accurate changes in labour productivity are difficult to measure. For example, if a firm hired its own maintenance workers rather than sub-contracting maintenance at the very time the training programme was introduced, the unwary might associate the training programme with a reduction in labour productivity.

Downtime is one possible output measure. Downtime variables include: downtime which disrupts output (though the impact of such downtime may depend on the time of day or year); the cost/time for maintenance; the wear and tear on the machines. In each case it is possible to capitalise the value of unused machinery and compare this with the cost of training.

The best output measure, and really the only one if it is desired to estimate the firm's rate of return to the training, is simply the *value of extra output* associated with training. It might be possible to calculate a "success rate" for the training defined as the actual output achieved compared with the expected output. However, there are problems in calculating the value of output in any before/after study. For example, it is necessary to control for aggregate inflation. Then again, one must decide whether or not to value the output in constant prices - i.e. to control for any change in the structure of relative prices over time. An additional problem in a before/after study is whether or not any change in output is demand-determined. For example, say port capacity is 100 ships per month but it was previously only working at two thirds capacity because of lack of demand. By coincidence, just after training is completed, demand increases so that it can now work full capacity. In such a case we must be careful not to attribute the increase in output to the training. Finally, in this measure of output, as in all others, it is necessary to make assumptions concerning the duration of the output increase associated with the training: should we assume, for example, that it will continue into the indefinite future?

The main benefits of vocational training may come in the form of cost reductions rather than output increases. For example Shiba (1983) indicates that training which raises skill levels in thermal power stations has three possible types of saving. First, fuel costs might be reduced by improving thermal efficiency. Second, repair costs will tend to be cut by quicker discovery and rectification of failures and accidents. Third, manpower inputs are likely to be reduced because operators have more diversified skills and there are fewer accidents and failures needing attention.

7.3 Benefits and costs

The benefits of vocational training can be weighed against the costs using the rate of return calculation or other measures outlined in Table 6.1. The major factors to be included in any such rate of return of similar calculation are set out in Table 7.1. As usual, the cost calculations are probably more straightforward than the measurement of benefits. For the firm the cost calculations are reasonably straightforward. One factor not explicitly included in the relevant box is the cost to the firm of any informal training on-the-job, but the firm-based studies of Ryan (1980) and Thomas et al. (1969) show that it may be possible to make such estimates. (For a clear exposition of costs see Arriagazzi 1972). The one real problem in the corporate cost calculation concerns the value of production during training. This might be calculated as follows:

Production rate of trainee (as proportion of that of a qualified worker) x Average earnings of qualified worker (on the assumption that this represents the productive value of a qualified worker)

But such a calculation turns on knowing the production rate of the trainee and on the correctness of the assumption that the earnings of the qualified worker represent his true worth.

TABLE 7.1

Costs and benefits to vocational training

Party	Costs	Benefits
Firm	Training cost i.e. instructors, fees to institutions etc. Earnings paid during training less trainee production during training	(Value of output post-training less increment in wages paid to workers who receive training, and others if there are knock-on effects in the internal labour market less What the value of output would have been without training) Multiplied by the retention rate plus intangibles like better discipline
Individual	Earnings foregone during training Tuition fees less earnings received during training	Earnings post tax post-training less earnings post tax pre-training
Social	Training cost Earnings foregone during training less positive production during training	Value of output post-training less what value of output would have been without training plus multiplier effects, replacement/displacement, externalities

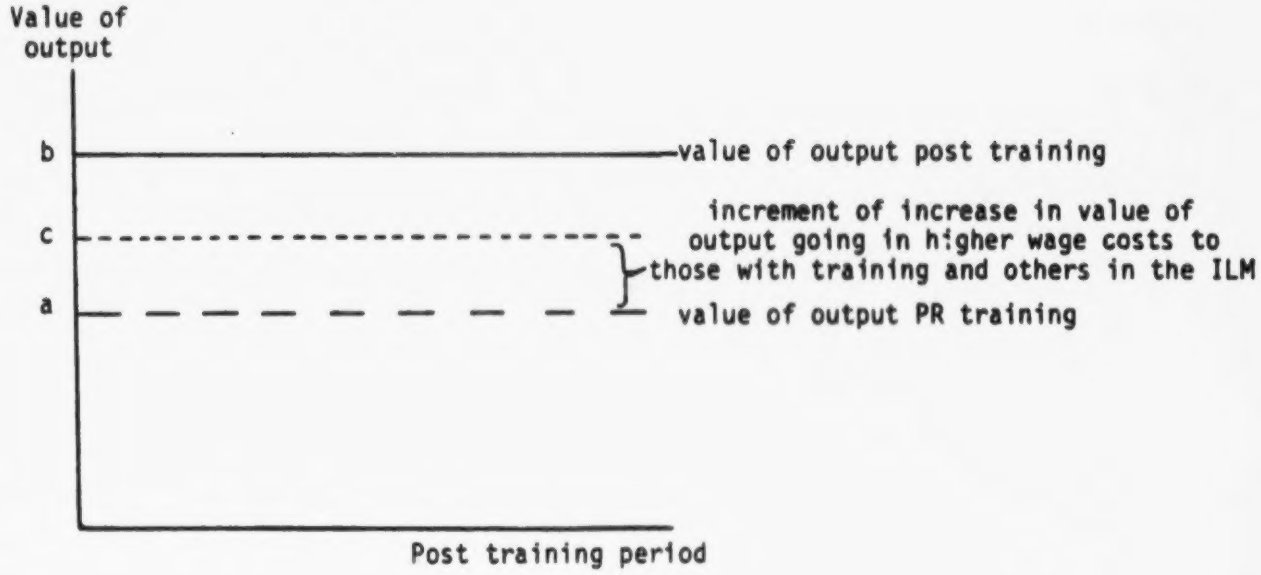
Note: Benefits can also be defined in terms of inputs saved rather than extra output.

Calculating the benefits to the firm is more problematic. It should be possible to calculate the value of output post training less what it would have been without the training, proxied by pre-training output. But from this increment in the value of output we must deduct the element paid in higher wages to those with training, and other workers if there are knock-on effects in the internal labour market. This is set out in Figure 7.1. The increment in the value of production associated with training is ab but the firm pays out ac of this to its workforce, leaving bc for the firm itself. If the higher output depends on the workers remaining with the firm bc must in turn be multiplied by the retention rate of those who experience the training. (It is worth noting in passing that this calculation of benefits may be more accurate than the corresponding information using earnings, which assumes that earnings adequately represent the value of output. Thus Cohen (1983) was forced to assume that the earnings of qualified workers represented the value of output post training and that newly-minted trainees got paid substantially less than their true worth, for up to twenty years. But here we deal with the actual value of output or inputs saved - road miles, electricity supply and so forth - before and after training and do not need to make such arbitrary assumptions).

Benefits of training may flow to the firm in the form of reduced inputs rather than higher output. Thus in his study of a power plant owned by the Tokyo Electric Power Company, Shiba (1983) reports a training benefit - cost ratio of 8-1. The benefits were not from lower fuel or repair costs but rather from a large reduction in workers per shift. In the particular power plant under study manpower per shift was cut from 18 in 1965 to 8 in 1982. Of this reduction in 10 people per shift, 3 were attributable to improvements in capital and 7 were attributable to the long run effect of the training programme.

FIGURE 7.1

Benefits to the firm from vocational training


Value of output
b
c
a
value of output post training
increment of increase in value of output going in higher wage costs to those with training and others in the ILM
value of output PR training
Post training period

The benefits to society are, as usual, difficult to calculate. First, spillover effects are likely to be large because much training will benefit other firms as trained workers leave. In some instances the trained workers will migrate abroad leaving no direct training benefits but indirect benefits via remittances home. Second, it is assumed that the increment between pre-training and post-training output represents the social benefit of the training. But changes over time in various institutional arrangements and market failures (e.g. the degree of regulation a utility faces in its pricing policy) may imply that the change in the value of output is a misleading measure of the benefits to society. Third, a true multiplier effect may exist: more road miles of better electricity supply may permit higher employment and income in the rest of the economy than would be possible with other uses of the resources used in road construction or electricity supply. Fourth, there will be a substantial positive externality if the trained person raises the productivity of those he works with in the firm (although this effect is captured by using the increment in the value of output as the benefit measure). The other externalities which plague cost benefit analysis of public training programmes - displacement and replacement - are not likely to be important with World Bank financed training because it is firm-based and embraces existing employees.

The calculation of the private benefits and costs of firm-level training is relatively straightforward. If the individuals are still in the firm, providing the firm has records of earnings it is a simple matter to calculate a private rate of return. Even if training was done some time ago and most training was institutional it should be possible to find an institution which keeps records of its students and then trace them and via a retrospective survey to calculate the payoff to the training that they received.

Any before/after study or twin study must attempt to control for factors other than training which influence output or input savings. First, is capital unchanged? Any increase in output must not be attributed to training if, in fact, it is due to more and better equipment. Presumably training will often go hand in hand with changes in capital. It may be possible to measure and control for any change in capital in a before/after study of one firm (although this would be difficult if the training component of a project is hand-in-hand with new plant). In any wider cross section it may be impossible to measure capital accurately. In such cross section studies capital may be best represented using Zymelman's (1976) ingenious proxy, the organisation of jobs in the plant.

Second, is the labour input constant? For example, it is necessary to control for the length of the workweek, the organisation of shifts, and changes in the education level of the labour force (independent of training). Perhaps most important, experience levels must be controlled for because it is possible output would have increased anyway (independent of training) simply because the labour force is gaining extra experience.

Third, is the management input constant? For example, have there been any changes in the organisational structure such as job content and lines of communication? Has there been a move towards an internal labour market in terms of recruitment and promotion policy. Has the motivation and performance of the workforce improved independently of training?

The single before/after study can indicate the payoff to that particular form of training but it says nothing about the relative merits of different forms (e.g. on/off the job) of vocational training. To make comparisons by different types of vocational training requires either before/after studies in two plants which are similar, except for type of training or a larger cross section where output can be related to type of training using statistical controls for other influences on output. Such studies would begin to permit us to compare the relative merits of (for example)

- getting an already trained person from abroad
- training someone with some education, either on/off the job
- training an illiterate, either on/off the job

Such a study would indicate different amounts of added training costs, because plants will differ in the amount of skilled labour they already have. Further, it would permit us to compare the relative merits of different types of vocational training such as passive exposure (work experience) and planned, programmed and supervised training.

7.4 Summary

Training may affect either output or inputs. There are three methods of analysing the impact of training on output. First, one plant can be studied before and after training. Second, twin plants can be studied, similar in all respects except that one has the training to evaluate and one does not. Third, a production function can be estimated, across a sample of plants, relating inputs, including training, to output.

The unit of observation can be either the individual or the plant. Individual-based output measures which would be useful in evaluating training include piecework earnings and performance rating. Using a sample of individuals the change in piecework earnings or performance rating before and after training can be related personal characteristics such as education and experience and to a variable which captures whether or not an individual has been exposed to training. *Plant* based output or input measures probably offer more promise if the aim is to estimate a cost-effectiveness or cost-benefit measure of firm level training. Reductions in downtime, extra output and lower input costs should, in principle, all be measurable and might then be related to training.

A rate of return to firm level training can be calculated for the firm, the individual and society. The major measurement problem in any such calculation concerns benefits, in particular it is difficult to pin down what would have happened without the training. In addition, the wider social return must take account of the impact of the trained labour on output elsewhere in the economy.

REFERENCES

Ahmed, E.,"Production Functions and Input Elasticities in the Construction of Low Cost Housing: A comparison of building firms in Pakistan with firms in five other countries", The Pakistan Development Review, 20, 4, Winter 1981. pp.417-426.

Arriagazzi, L., "Chile: evaluating the expansion of a vocational training programme" in P.H. Coombs and J. Hallak, eds., Educational cost analysis in action: case studies for planners, Vol. I, IIEP-UNESCO, 1972.

Ashenfelter, O., "Effects of manpower training on earnings: preliminary results", IRRA Proceedings, December 1974.

Ashenfelter, O., "Estimating the effects of training programmes on earnings", Review of Economics and Statistics, 60, 1, 1978.

Ashenfelter, O., "Estimating the effect of training programmes on earnings with longitudinal data", Research in Labor Economics, Supplement 1, 1979, pp.97-118.

Barnow, B.S., "Theoretical issues in the estimation of production functions in manpower programs", Research in Labor Economics, Supplement 1, 1979, pp.295-338.

Bassi, L., "The effect of CETA on the postprogram earnings of participants", Journal of Human Resources, 18 (4), Fall 1983, pp.539-556.

Bassi, L., "Estimating the effect of training programs with non-random selection", Review of Economics and Statistics, February 1984, pp.36-43.

Bennell, P., "The utilization of professional engineering skills in Kenya", IDS, Sussex University, (no date).

Blaug, M., An Introduction to the Economics of Education, Penguin, 1972.

Bloch, F.E., "Introduction", Research in Labor Economics, Supplement 1, 1979, pp.1-8.

Bloch, F.E.,(editor), Evaluating manpower training programs, Greenwich Conn.: JAI Press 1979 (Supplement to Research in Labor Economics, 1979).

Borus, M.,(editor), Evaluating the impact of manpower programs, D.C. Heath, 1972.

Borus, M.E., "A cost effectiveness comparison of vocational training for youth in developing countries: a case study of four training modes in Israel", Comparative Education Review, 21, 1, February 1977, pp.1-13.

Bowles, S., "Aggregation of labour inputs in the economics of growth and planning: Experiments with a two-level CES function", Journal of Political Economy, 78, 1970, pp.68-81.

Brown, J.N., "Are those paid more really no more productive? Measuring the relative importance of tenure versus on-the-job training in explaining wage growth", Working Paper 169, Princeton University Industrial Relations Section, October 1983.

Brown, M. and Kiefer, C., "Managerial evaluation model for secondary vocational education in Michigan", The Journal of Vocational Education Research, 5, 1, 1980.

Castro Moura, C. de., "Vocational education and the training of industrial labour in Brazil", International Labour Review, 118, 5, September-October 1979, pp.617-629.

Claydon, S., "Counting our skills: the National Training Survey", Department of Employment Gazette, November 1980, pp.1150-1154.

Cohen, S., "Malaysia: a case for in-service industrial training", World Bank Education Division, East Asia and Pacific Regional Office, 2 May 1983.

Collier, P. and Bigsten, A., "A model of educational expansion and labour market adjustment applied to Kenya", Oxford Bulletin of Economics and Statistics, 1981, pp.31-48.

Conlisk, J., "Choice of sample size in evaluating manpower programs: comments on Pitcher and Stafford", Research in Labor Economics, Supplement 1, 1979, pp.79-96.

Cooley, T.M., McGuire, T.W. and Prescott, E.C., "Earnings and employment dynamics of manpower trainees: an exploratory econometric analysis", Research in Labor Economics, Supplement 1, 1979, pp.119-148.

Davie, B.F., and Duncombe, B.F., Public Finance, New York: Holt, Rinehart and Wilson Inc., 1972.

Drake, K., "The cost effectiveness of vocational training: a survey of British Studies", Economics of Education Review, 2, 2, Spring 1982, pp.103-125.

Ehrenberg, R.G., "An evaluation of two evaluations", Research in Labor Economics, Supplement 1, 1979, pp.149-158.

Fallon, P.R. and Layard, P.R.G. "Capital-skill complementarity, income distribution and output accountings", Journal of Political Economy, 83, 1975, pp.279-301.

Foster, P.J., "The vocational school fallacy in development planning", in Anderson, C. and Bowman, M. (Editors), Education and Economic Development, Cass, 1966.

Fredland, J.E., and Little, R.D., "Long-term returns to vocational training: evidence from military sources", Journal of Human Resources, 15(1), Winter 1980, pp.49-66.

Freeman, R.B., "Manpower requirements and substitution analysis of labor skills: a synthesis", Research in Labor Economics, 1, 1977, pp.151-183.

Fuller, W.P., "More evidence supporting the demise of pre-employment vocational trade training: a case study of a factory in India", Comparative Education Review, 20, 1, February 1976, pp.31-41.

Gay, R. and Borus, M., "Validating performance indicators for employment and training programs", Journal of Human Resources, 15, 1, 1980.

Godfrey, M., "Education, training and productivity: A Kenyan case-study", Comparative Education Review, 21, 1, February 1977, pp.29-36.

Goodfellow, G.P., "Estimates of the benefits of training for four manpower training programs", Research in Labor Economics, Supplement 1, 1979, pp.187-222

Greenhalgh, C., and Stewart, M., "The effects and determinants of training", Warwick Economic Research Papers, 213, August 1982.

Hall, R.E., "Comment" on Johnson (1979), Research in Labor Economics, Supplement 1, 1979, pp.255-258.

Hamermesh, D.S. and Grant, J., "Econometric studies of labour - labour substitution and their implications for policy", Journal of Human Resources, 13, 4, 1979, pp.518-542.

Hardin, E., "Benefit-cost analyses of occupational training programs: a comparison of recent studies" in G. Somers and W. Wood (Editors), Cost-benefit analysis of manpower policies, 1969.

Harris, M. and Holmstrom, B., "Ability, performance and wage differentials", Review of Economic Studies, 49(3), July 1982, pp.315-333.

Hilowitz, J., Tracer studies as tools for identifying training needs: an evaluation, ILO, Training Department, September 1983.

Hinchcliffe, K., "Manpower planning and labour substitution", Nigerian Journal of Economic and Social Studies, 14, 1, 1972, pp.129-132.

Horowitz, S.A. and Sherman, A., "A direct measure of the relationship between human capital and productivity", Journal of Human Resources, 15, 1, 1980, pp.67-76.

House, W.J. and Rempel, H., "The impact of unionisation on negotiated wages in the manufacturing sector in Kenya", Oxford Bulletin of Economics and Statistics, May 1976, pp.111-123.

Hughes, J., "The location of Government Training Centres", International Journal of Social Economics, 2(3), 1975, pp.183-205.

Hunting, G., Zymelman, M. and Godfrey, M., "A manual for the evaluation of vocational training", Education Department, World Bank, 1984.

International Labour Office, Employment incomes and equality: a strategy for increasing productive employment in Kenya, Geneva, 1972.

Johnson, G.E., "The labor market displacement effect in the analysis of the net impact of manpower training programs", Research in Labor Economics, Supplement 1, 1979, pp.227-254.

Johnson, P.S. and Thomas, R.B., The evaluation of training for self-employment: a social cost benefit analysis, University of Durham, mimeo 1982.

Jones, I. and Hollenstein, H., "Trainee wages and training deficiences: an economic analysis of a British problem", National Institute of Economic and Social Research, DP.58, June 1983.

Kaitz, H.B., "Potential use of Markov process models to determine program impact", Research in Labor Economics, Supplement 1, 1979, pp.259-284.

Kiefer, N.M., "The economic benefits from four Government training programs", Research in Labor Economics, Supplement 1, 1979, pp.159-186.

Kiefer, N.M., "Population heterogeneity and inference from panel data on the effects of vocational education", Journal of Political Economy, 87, 5, Part 2, October 1979, pp.213-226.

Knight, J.S.,"Black wages and choice of techniques in South Africa", Oxford Bulletin of Economics and Statistics, 2, 41, 1979, pp.117-144.

Knight, J.B. and Sabot, R.H., "Labour market discrimination in a poor urban economy", Journal of Development Studies, October 1982, pp.67-87.

Knight, J.B. and Sabot, R.H., "The role of the firm in wage determination: an Africa case study", Oxford Economic Papers, 35, 1, March 1983, pp.45-66.

Layard, R., Sargan, D., Agar, M. and Jones, D., Qualified manpower and economic performance, Allen Lane, 1971.

Lazear, E.P., "Agency, earnings profiles, productivity and hours restrictions", American Economic Review, 71(4), September 1981, pp.606-620.

Levine, V., "Evaluating vocational training alternatives using single period earnings data: a technical note", Comparative Education Review, 23, 1, February 1979, pp.125-133.

Lim, D., "Do foreign companies pay higher wages than their local counterparts in Malaysian manufacturing?", Journal of Development Economics, 4, 1977, pp.55-56.

Lockheed, M., Jamison, D. and Lau, L., "Farmer education and farm efficiency: a survey", Economic Development and Cultural Change, 29, 1, October 1980.

Manpower Services Commission, Towards an Adult Training Strategy, April 1983.

Manpower Services Commission, Annual Report 1982/83, July 1983.

Marshall, A., Industry and Trade, Macmillan: London, 1919.

Medoff, J.L. and Abraham, K.G., "Experience, performance and earnings", Quarterly Journal of Economics, 95, 4, December 1980, pp.703-736.

Medoff, J.L., "Are those paid more really more productive? The case for experience", Journal of Human Resources, 16, 2, 1981, pp.186-216.

Medoff, J.L., "Formal training and labor productivity", Harvard University, mimeo, October 1982.

Metcalf, D. and Nickell, S., "Occupational mobility in Great Britain", Research in Labor Economics, 5, 1982, pp.319-357.

Miller, R.U. and Zaidi, M.A., "Human capital and earnings: some evidence from Brazil and Mexico", IRRA Proceedings, 1981, pp.207-215.

Mingat, A., "Measuring the economic efficiency of Project Related Training: some evidence from Agricultural Projects", Education Department, World Bank, January 1984.

Morell, J., "Follow-up research as an evaluation strategy: theory and methodologies", in Abramson, T., Tittle, C.K., and Cohen, L., (eds.) Handbook of Vocational Education Evaluation, Sage Publications, 1979.

Nissim, J., "The price responsiveness of the demand for labour by skill: British Mechanical Engineering 1963-1978", London School of Economics, Centre for Labour Economics, Discussion Paper No. 122, April 1982.

Nollen, S.,"The causes and consequences of industrial training"(outline of a research project), mimeo, Institute of Education, London University, 1983.

O'Neil, D., "Voucher funding of training programs: evidence from the GI Bill," Journal of Human Resources, 12(4), Fall 1977, pp.425-445.

Pack, H., "Aggregate implications of factor substitution in industrial processes", Journal of Development Economics, 11, 1982, pp.1-37.

Picciotto, R., "Chile vocational training project - a cost-benefit calculation", mimeo, World Bank, 26 January 1965.

Pitcher, H.M., "A sensitivity analysis to determine sample sizes for performing impact evaluation of the CETA programs", Research in Labor Economics, Supplement 1, 1979, pp.37-78.

Prais, S.J., "Vocational qualifications of the labour force in Britain and Germany", National Institute Economic Review, 98, November 1981, pp.47-59.

Psacharopoulos, G. and Hinchcliffe, K., "Further evidence on the elasticity of substitution among different types of educated labour", Journal of Political Economy, 80, 1972, pp.786-792.

Psacharopoulos, G., "Lifetime profiles of earnings and employment: a survey", Social Science Information, 20, 4/5, 1981, pp.743-785.

Psacharopoulos, G., "Peru: assessing priorities for investment in education and training", Peru Mission, World Bank, 16 November 1982.

Psacharopoulos, G., "Education and private versus public sector pay", Labour and Society, 8 (2), April-June 1983, pp.123-134.

Psacharopoulos, G., Hinchliffe, K., Dougherty, C. and Hollister, R., Manpower Issues in Educational Investment: a consideration of Planning Processes and Techniques, World Bank Staff Working Papers 624, November 1983.

Psacharopoulos, G. and Loxley, W., "Diversified Secondary Education and Development: a Report on the Diversified Secondary Curriculum Study (DiSCuS)", Education Department, World Bank, 1984.

Puryear, J.M., "Vocational training and earnings in Columbia: does a SENA effect exist?", Comparative Education Review, 23, 2, June 1979, pp.283-292.

Ryan, P., "The costs of job training for a transferable skill", British Journal of Industrial Relations, 18, 3, November 1980, pp.334-352.

Sawhney, P., Jantzen, R. and Herrnstadt, I., "The differential impact of CETA training", Industrial and Labor Relations Review, 35(2), January 1982, pp.243-251.

Scott, L.C., "The economic effectiveness of on-the-job training: the experience of the Bureau of Indian Affairs in Oklahoma", Industrial and Labor Relations Review, January 1970, pp.220-236.

Selby-Smith, C., The costs of further education: a British analysis, Oxford: Pergamon Press, 1970.

Shiba, S., "Proposal for the measurement of benefits and costs of training in project related training: a case study of thermal power stations", mimeo, Education Department, World Bank, October 1983.

Sorge, A. and Warner, M., "Manpower training, manufacturing organization and workplace relations in Great Britain and West Germany", British Journal of Industrial Relations, 18(3), November 1980.

Stafford, F.P., "A decision theoretic approach to the evaluation of training programs", Research in Labor Economics, Supplement 1, 1979, pp.9-36.

Staley, E., Planning occupational education and training for development, New York, Praeges 1971.

Stern, D., "Economic feasibility of on-the-job training", Economics of Education Review, 2(2), Spring 1982, pp.157-173.

Stromsdorfer, E.W., Review and synthesis of cost-effectiveness studies of vocational and technical education, Centre for Vocational and Technical Education, Information Series No. 57, 1972.

Thomas, B., Moxham, J. and Jones, J., "A cost-benefit analysis of industrial training", British Journal of Industrial Relations, 7, 2, July 1968, pp.231-264.

Tinbergen, J., "Substitution of graduate by other labour", Kyklos, 27, 1, 1974, pp.1-18.

Tinbergen, J. and Psacharopoulos, G., Long range educational perspectives in OECD countries: a review of issues and some policy proposals, in press, OECD, 1983.

World Bank, "Chile vocational training project-cost-benefit calculation", Office Memorandum, 26 January 1965.

World Bank, Education: sector policy paper, Third Edition, April 1980, Washington D.C.

World Bank, "Guideline for the preparation, implementation and evaluation of training components in World Bank Power Projects", Training Unit, Education Department, Operations Policy Staff, mimeo, (no date).

World Bank, Review of training in Bank-financed projects, Operations Evaluation Department, Report No.3834, March 1982.

World Bank, Philippines, Staff Appraisal Report, Vocational Training Project, Report o, 37506-PH, Projects Department, East Asia and Pacific Regional Office, August 1982.

World Bank, Staff Appraisal Report, Indonesia, Public Works Manpower Development Project, Report No.4173, Projects Department, East Asia and Pacific Regional Office, March 1983.

Ziderman, A., "Costs and benefits of adult retraining in Great Britain", Economica, November 1969.

Ziderman. A., "Cost-benefit analysis of Government Training Centres in Scotland: a simulation approach", in Parkin, M., and Nobay, A., (editors), Contemporary Issues in Economics, Manchester University Press 1975.

Ziderman, A., "Costs and benefits of manpower training programmes in Great Britain", British Journal of Industrial Relations, July 1975 (1975a).

Ziderman, A., "Evaluation of manpower programs: control groups versus before-after comparisons", Journal of Industrial Relations, March 1976.

Ziderman, A., "The regional location of training centres in Britain: a cost-benefit approach", International Journal of Social Economics, 4 (1), 1977 p.32-49.

Ziderman, A., Manpower Training: Theory and Policy, Macmillan: London 1978.

Ziderman, A.,"Costs and benefits of adult training in Israel: the viewpoint of society and the individual", Bar-Ilan University, mimeo, no date.

Ziderman, A. and Driver C., "A Markov chain model of the benefits of participating in Government training schemes", Manchester School, December 1973.

Zymelman, M., The economic evaluation of vocational training programs, World Bank Staff occasional papers No.21, John Hopkins Press, 1976.

The World Bank

Headquarters
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.

Telephone: (202) 477-1234
Telex: WUI 64145 WORLDBANK
RCA 248423 WORLDBK
Cable Address: INTBAFRAD
WASHINGTONDC

European Office
66, avenue d'Iéna
75116 Paris, France

Telephone: (1) 47.23.54.21
Telex: 842-620628

Tokyo Office
Kokusai Building
1-1 Marunouchi 3-chome
Chiyoda-ku, Tokyo 100, Japan

Telephone: (03) 214-5001
Telex: 781-26838

Future Considerations

169

ISSN 0253-2115/ISBN 0-8213-0475-5